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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

FEBRUARY, 1925

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O. F. Cook

EDUCATION AND FECUNDITY
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THE COLORSIDED PATTERN IN CATTLE
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ALBINO WATER BUFFALOES IN CHINA
C. O. Levine

THE CAUSES OF CANCER
A Review

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TERRACE AGRICULTURE OF ANCIENT PERU

Frontispiece

The ancient Peruvians carried the art of agriculture to the highest, most specialized development that has been attained in any part of the world. Their system of agriculture included not only the use of fertilizers to enrich the soil and irrigation through long artificial channels, but also the lands that were cultivated were largely of artificial construction. The photograph shows a stretch of artificial land in the Valley of the Urubamba river near Pisac, a few miles below Cuzco. At this point the bed of the river was straightened and walled and the reclaimed area terraced and covered with artificial soil. The fields that appear as a general level are formed of broad terraces, with narrower terraces on the lower slopes of the mountain and smaller irregular terraces in the coves above.

PERU AS A CENTER OF DOMESTICATION

Tracing the Origin of Civilization Through the Domesticated Plants

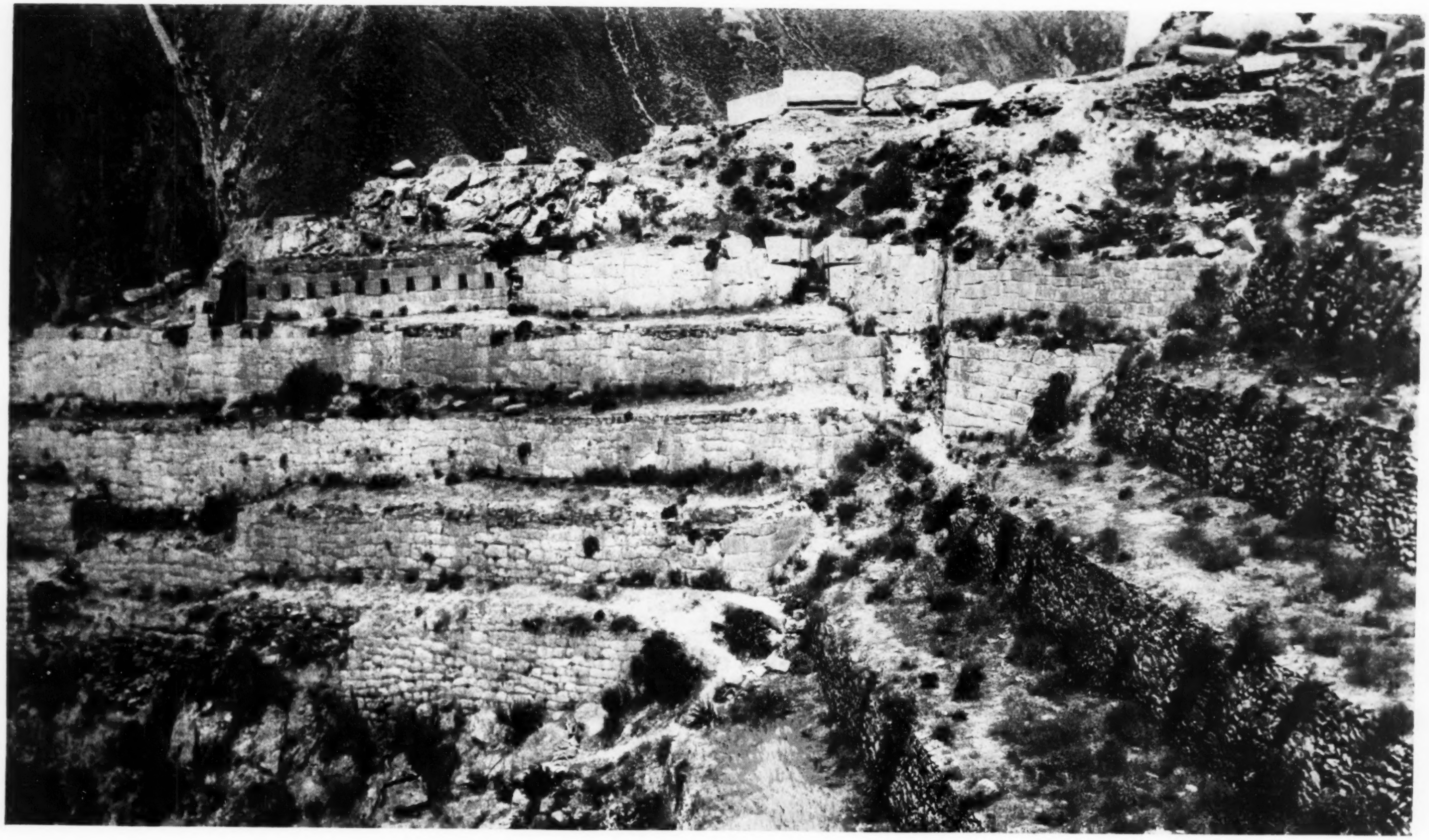
O. F. Cook
U. S. Department of Agriculture

CIVILIZATION rests upon agriculture, and agriculture upon the domestication of plants. The most primitive savages wander in search of food, like predatory animals. To maintain a food supply, storage or cultivation is required, or a combination of the two. With a settled existence achieved, the experience of successive generations begins to accumulate, and an advance toward civilization becomes possible. "That there may be permanence and progress in society the individuals who compose it must be located." This necessity of location was supplied by a threefold domestication, of plants, animals and fire. For primitive man, the fire also was a living creature which had to be tended and fed, in order to keep it alive. Domestication was the great achievement which enabled primitive man to attain what may be considered as a human existence.

With every extension of agriculture into different regions, primitive man was under the necessity of domesticating more plants or animals. Eventually civilization became possible over a large part of the earth's surface, when enough plants and animals had been domesticated to meet the requirements of the different conditions. Such domestications must have been accomplished at a very primitive stage, while recourse was still had to wild food products in times of scarcity, so that there were practical tests of the edible qualities of many species. Thus it appears that all of the important food plants were domesticated before the historical period, or several thousand years ago. On account of the great antiquity, it is not easy to determine whether different systems of agriculture arose independently or an extension of agricultural habits took place, from one original center. Only a few writers have considered the possibility of reconstructing the early stages of human progress and eventually locating the original seats of civilization by tracing the biological relations of the domesticated species.

Tracing the origin and places of domestication of cultivated plants is of present-day agricultural importance as well as of historical or ethnological interest. Knowledge of the wild prototypes of cultivated plants is essential to a full understanding of problems of adaptation and breeding, and for developing more vigorous and resistant varieties to replace any that become weak or diseased. The most specialized adaptations to particular conditions of growth are likely to be found in the regions where the plants have been cultivated for the longest periods. Also the greatest accumulations of experience in cultivating, propagating and using the various domesticated species are likely to be found in their native regions.

If cultivation arose independently in different parts of the world, as many writers have assumed, the several points of origin would represent as many centers of domestication of plants, where different systems of agriculture had separate beginnings. In view of the very slow adoption of civilization and of agricultural improvements, even in the more advanced countries, and the failure of so many peoples to maintain the civilizations that are known to have existed formerly in many regions, the theory of multiple origins and inde-



MEGALITHIC TERRACES AT OLLANTAYTAMBO

Figure 1

A perfection-point of prehistoric agriculture. Five of the megalithic terraces are shown, built of hard, white granite, the stones of irregular form but fitted together with an incredible nicety, showing that a high state of artistic ability as well as of social organization existed at a remote period. Enormous blocks of red granite that must have been transported for several miles are shown above the terraces. For other photographs see "Staircase Farms of the Ancients, *National Geographic Magazine*, May, 1916.

HIGH ALTITUDE VALLEY

Figure 2

A valley in the high table land near Sicuani at an altitude of about 12,000 feet, where the valleys are not so deeply eroded and there is land that can be cultivated without terracing.

pendent developments of primitive civilizations is less easily credited. To locate the primary centers of domestication as definitely as possible would appear to be the first step in a biological investigation of the conditions and stages of human progress in prehistoric times.

In the present state of botanical science there can be no question that each of the cultivated plants had an original status as a wild species, and was adopted by primitive man at some time and place, which it is our problem to locate as definitely as possible. The domestication of a new food plant was a step of the utmost importance in the subsequent history of mankind, not only in the country of origin but even in remote regions to which many plants have been carried. No other physical cause of the modern industrial and political ascendency of northern Europe is so important as the introduction of the potato from the tablelands of Peru, which has enormously increased the productive possibilities of Germany and other northern countries, and thus made possible the recent "World War." Although the extensive cultivation of the potato in Europe and North America began only in the last century, it already has influenced the course of history to a notable extent. It may not be long before the study of civilization will be reckoned as a branch of biology, instead of being approached through philosophical abstractions. A higher plane of agricultural consciousness is being reached and the tendency of historical writers and ethnologists to leave agriculture out of account undoubtedly will be corrected.

The backward state of knowledge and thought in relation to the plant basis of our existence is difficult to understand, except as another striking illustration of the tendency of the human mind to reach out to distant or mysterious things and neglect what is close at hand. Hardly a century has passed since the art of systematic selection of crop plants was revived in Europe, and the possibilities of intro-

Enormous blocks of red granite that must have been transported for several miles are shown above the terraces. For other photographs see "Staircase Farms of the Ancients," *National Geographic Magazine*, May, 1916.

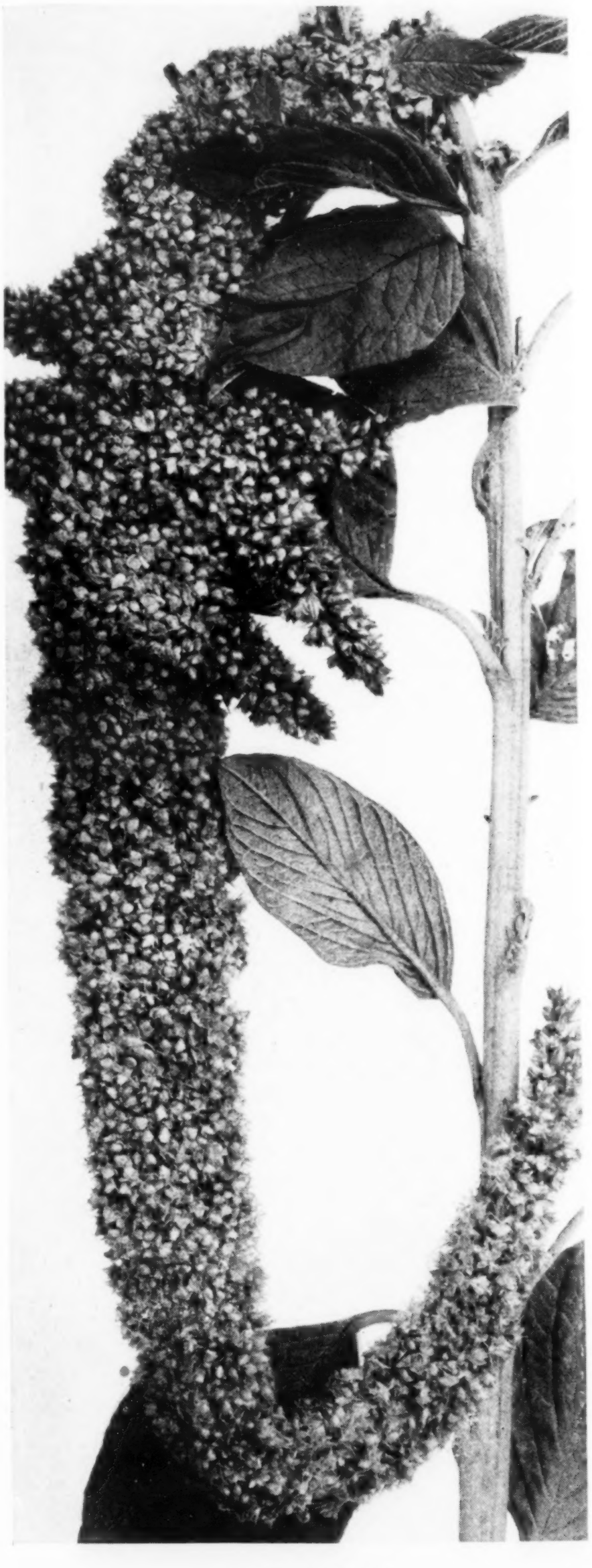
ducing new crops began to be seriously considered. Though many chance introductions had been made since the times of the Crusades and the discovery of America, the need of a thorough investigation of such possibilities of improvement of agriculture is only beginning to be appreciated.

It was well known to the Romans that superior sorts of plants as well as of animals could be developed by selection, and that deterioration follows when selection is neglected, but this knowledge was lost for centuries and is only now being recovered. The Romans had a highly developed agriculture which fell into decay when the energies of the nation were devoted to urban pursuits and to exploitation of foreign countries. Without an agricultural background, the facts of history can have little of practical significance for avoiding mistakes of the past or finding safely progressive courses for the future.

Plants Domesticated Before Animals

The traditional assumption of an original pastoral state as the first step in the development of the art of agriculture is hardly to be maintained, because the wandering life of shepherds and herdsmen is not a favorable condition for the domestication of plants. A predatory animal like the dog, with a strong instinct for running in packs and following an accustomed scent, might be adopted readily, even by the roaming savages of a pre-agricultural age, but the domestication of grazing animals is different and would be much easier for people adready adapted to a settled existence. Thus the domestication of animals may be considered as a secondary problem, a consequence rather than a cause of the domestication of plants.

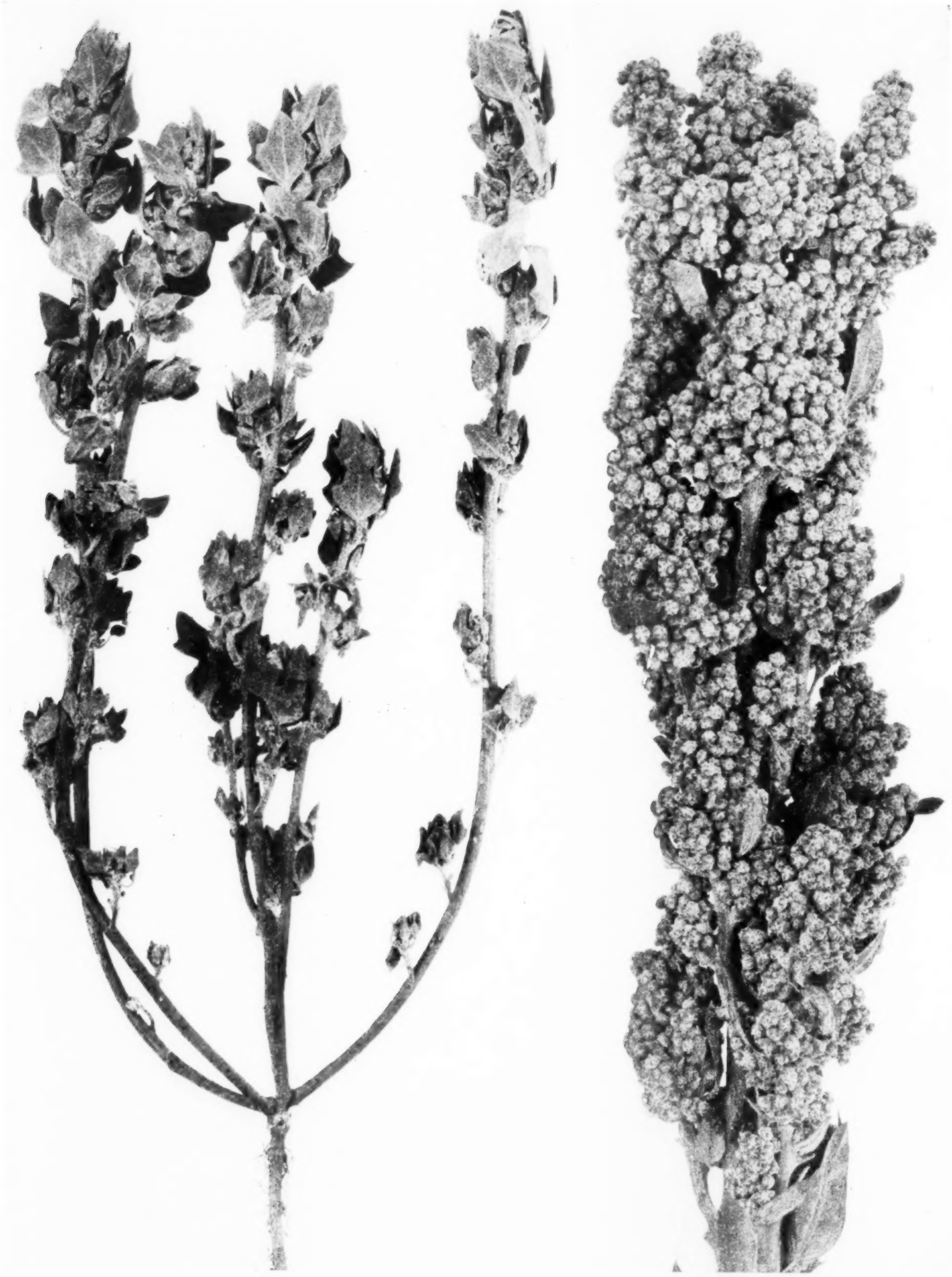
On the other hand, it need not be supposed that all pastoral peoples have previously been cultivators, though some undoubtedly have been. Primitive neighbors of agricultural people may adopt domesticated animals before they



QUIHUICHA

Figure 3

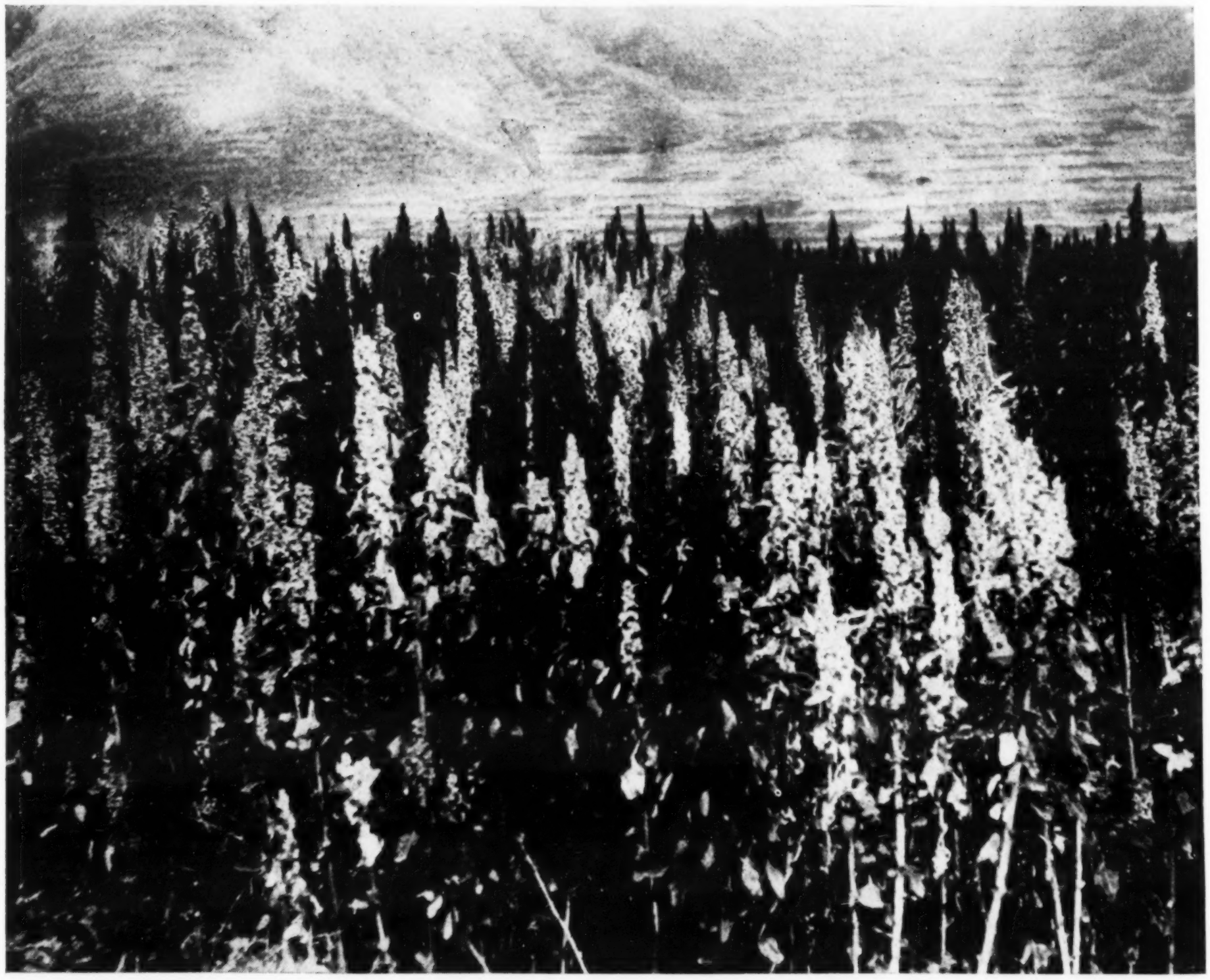
Amarantus caudatus, one of the "pigweeds" grown as seed-crops. This plant is cultivated in the temperate valleys of southern Peru in the district of Ollantaytambo. The seeds "pop" like Indian corn, and taste much the same. (Natural size.)



PIG-WEEDS AS SEED CROPS

Figure 4

Two species of pig-weeds, the well-known *Chenopodium quinoa* and the smaller and less known *C. canihua,* are grown for their seeds in the table-lands of southern Peru, especially at high altitudes where the seasons are too short for Indian corn. Quinoa is raised in large quantities, mostly for brewing the native beer, though the seeds of white varieties can be boiled and eaten like oat-meal. The small species, canihua, is sown after potatoes at the upper limit of cultivation, above 14,000 feet, and is used as a travel ration by the shepherds who go out with the herds of llamas and alpacas. See Foot-Plow Agriculture in Peru, Smithsonian Report for 1918.



A FIELD OF QUINOA

Figure 5

The plants grow to about four feet high and form a dense mass of seed at the top, the seed cluster of a small plant being shown in natural size in Figure 4. The heads are of several colors, red, pink, yellow, and white. Attempts have been made to introduce quinoa into the United States, but thus far without success.

adopt plants. Like the patriarchs of the Old Testament, the Navajoes of New Mexico now have large herds of sheep and cattle, but we know that these are a recent acquisition, and that such cases do not prove an original pastoral state, preceding the domestication of plants. Payne has considered that the domestication of animals would require a settled existence, though not recognizing the need of a prior domestication of plants as the basis of such a mode of life.

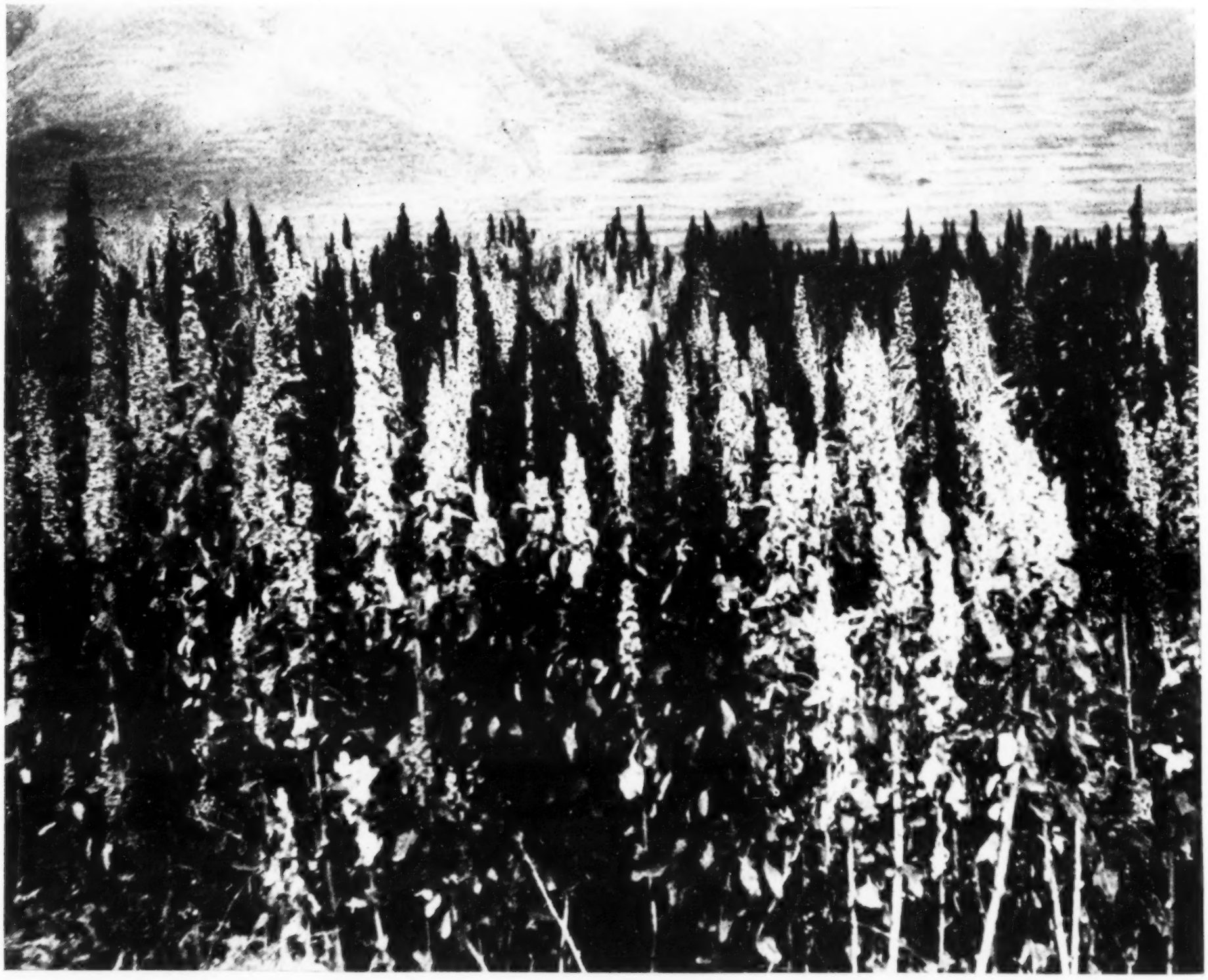
On account of our familiarity with the histories, traditions, languages, and ruins of the Mediterranian countries, greater antiquity of civilization in that part of the world is generally assumed, emerging from a background of pastoral life, but the domestication of plants must have begun in remotely prehistoric times. The histories of Egypt and Chaldæa are being read, and show that many plants, and animals as well, had been domesticated and used for centuries and milleniums before the days of Abraham. The problem of domestication should be approached with as little of historical bias as possible, if the biological indications are to be appreciated.

Our historical prejudice is so great as to make it very difficult to consider such a possibility as that of civilization

COCAINE INSTEAD OF TOBACCO

Figure 6

The coca shrub, which furnishes cocaine, is cultivated and used extensively in Peru. Though tobacco was known to the ancient Peruvians it was considered injurious, while the chewing of coca leaves was a universal habit of the male Indians. Coca is a handsome plant, with white, scarlet berries and rather delicate pea-green leaves. (Natural size.)



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having originated outside of the traditional area of the Mediterranean countries and Western Asia. It has required 400 years since the discovery of America for us Europeans to begin to realize that there was a really indigenous development of civilization in America. It is still very difficult for many intelligent people and even for scientific investigators to see that the origin and development of agriculture in America is to be recognized as a fact that stands on its own separate foundation of evidence, quite apart from any traditions regarding the development of civilization in the Eastern Hemisphere, our so-called "Old World."

Agriculture Indigenous in America

That the agriculture of the native peoples of North and South America was not introduced from the Old World but had an independent, indigenous development, is demonstrated by the fact that the American agriculture was based on native American plants. The assumption of Old-World origin of the primitive civilizations of America has been debated for 400 years, from the days of Columbus to the present time, without reaching a definite conclusion from historical, ethnological or linguistic data, but the evidence of the plants is unequivocal, and no other evidence appears so definite and conclusive, from a biological standpoint.

Biologists are familiar with the fact that the different families, genera and species of plants and animals have definite geographic distributions, but historians or other writers who do not have a biological outlook may leave out of account some of the most significant factors in locating the centers of primitive culture. The essential relation of the cultivated plants to the development of civilization in America was stated long ago by Martius and has been recognized by Payne and other more recent writers, though still commonly overlooked.*

From the present-day knowledge of the cultivated plants it appears that the traditional ancient world of our civilization, in the Mediterranean countries, was not the scene of an indigenous growth of agriculture and the attendant arts. Each of the important crops, as well as the industrial products of the ancient Romans, Greeks and Phoenicians, when traced back, is found to have been exotic. The linguistic and archaeological indications are in line with the ancient traditions of successive introductions of grapevines, fruit trees and cereal crops. In the Old World the search for the origin of civilization has led to no definite indication of the place or the conditions where domestication was first accomplished and the early stages of agricultural development were passed.

Some of the historians recognize that the natural conditions of Egypt and Mesopotamia were those of swampy forested flood plains, which needed to be reclaimed by people already accustomed to the practice of irrigation and other specialized methods of agriculture. Such alluvial valleys are fertile and can be made permanently productive, but the natural flood-plain conditions were not favorable for the domestication of cereals, nor even for the existence of most of the crop plants in a wild state.

Archaeologists now concede that the first civilizations of Egypt and Assyria were not indigenous, but were brought by a foreign race supposed to have come into both countries from southern Arabia. The art of agriculture already had reached a highly developed state when it was introduced into Egypt and Assyria. A prehistoric civilization existed in southern Arabia, as shown by remains of agricultural terraces and massive stone-work, but there the trail ends, unless eastern origins are sought. That the island of Madagascar was occupied, as well as the East Indian and Pacific islands, by a prehistoric

*Martius, C. F. P. von, 1867. *Ethnographie und Sprachenkunde Amerikas.*
Payne, E. J., 1892. *History of the New World Called America.*

seafaring people with a highly developed system of agriculture, is a fact that may have significance in the general history of agriculture. Linguistic similarities have been claimed by philologists between the Oceanic languages and the ancient Semitic and Aryan tongues. Of course, the traditional assumption has been that any prehistoric influences must have extended from Egypt or Assyria, from India or China, to the Pacific islands or to the American continent. The possibility of a prior development of agriculture and primitive civilization in America has received little consideration.*

In Peru, on the other hand, there is no such difficulty in visualizing a primitive state of agriculture, which still exists among the native people of the narrow, pent-in valleys of the eastern slopes of the Andes. No other conditions appear so well calculated for forcing a primitive people to domesticate and propagate plants as these gorge-like valleys, commonly a mile deep and rimmed above with perpendicular cliffs or with perpetual snow. The primitive people who took refuge in these valleys were under the greatest imaginable pressure to make use of every local means of subsistence, since they were precluded from the usual recourse of savages who wander about in search of food.

In the modern Quichuas, as the native agricultural people of the higher Peruvian valleys are called, we may see the representatives of an ancient people still surviving under conditions where agriculture certainly was not borrowed or introduced from abroad, but appears to have been strictly indigenous. That the native farmers of Quichua-land are a very simple and rude people does not render them less interesting, but leaves them the nearer to the primitive conditions of existence that supported and made possible the higher development of the native culture of the Inca and pre-Inca periods. The same conditions of isolation and restriction to small communities, that may have forced the ancient people to domesticate plants and become agricultural, still tend to keep people in the same places and hold them to a very primitive existence, notwithstanding the lapse of time, which may be very great. Though the Inca empire, overturned by Pizarro, probably had not been established for many centuries, several earlier epochs of pre-Inca civilization are now recognized by archaeologists, on the basis of different types of megalithic stonework. Indeed, the most massive and finely fitted stonework is now ascribed to the pre-Inca ages.

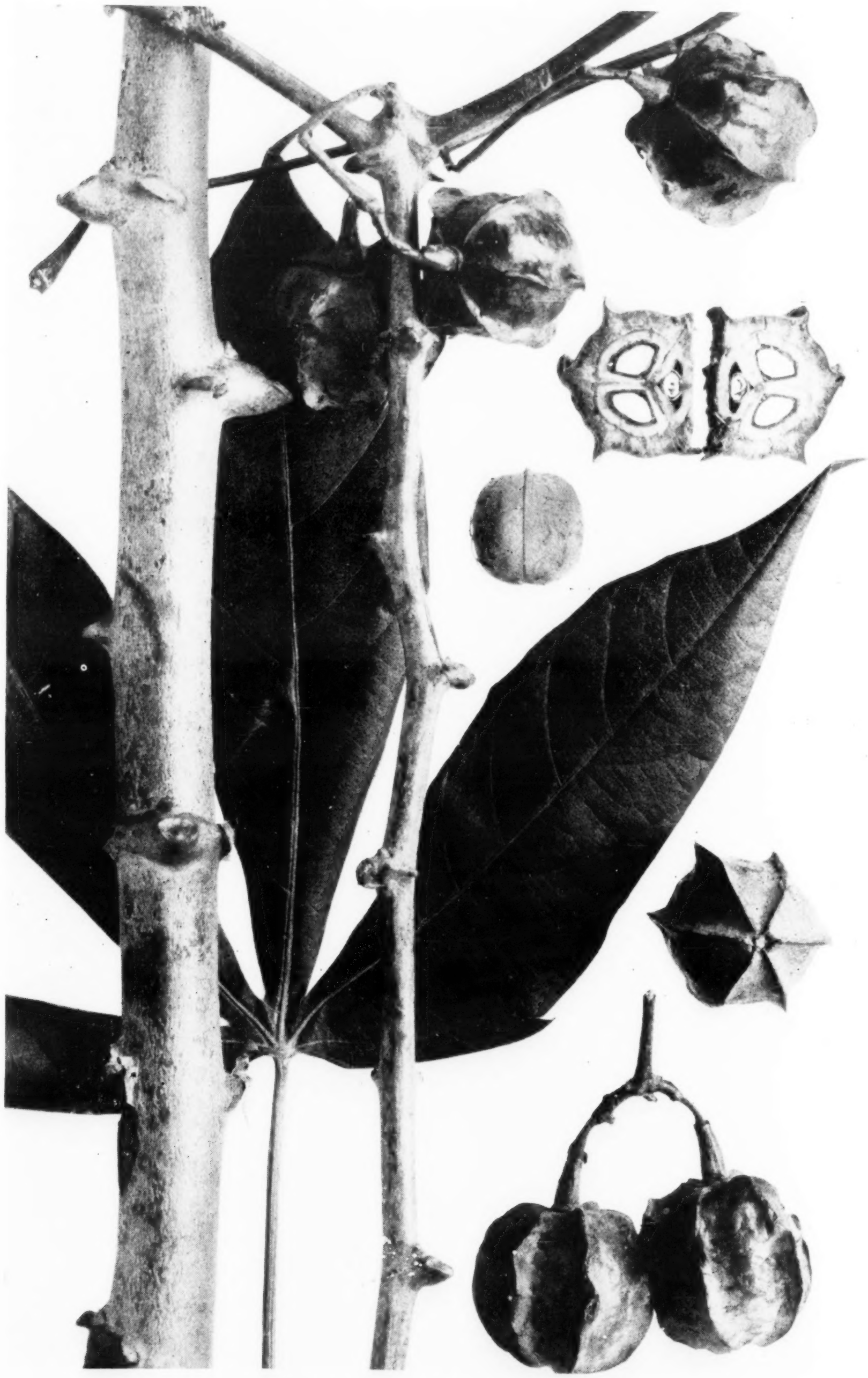
Relative Antiquity of Domestication

Biology shows that the system of agriculture was indigenous in America, since American plants were used, and also affords indications of the great antiquity of agriculture in America. Such evidence comes from comparing the cultivated species of plants with their nearest wild relatives. Such comparisons in America show many cases of wide divergence, so wide, in fact, that it has not been possible to identify with certainty the wild type of several of the most important species, as corn, tobacco, beans, peanuts, potatoes, and tomatoes. In this there is a striking contrast with the results of similar studies of the cultivated plants of the Old World, where most of the cultivated species have wild prototypes that are very easily recognized. The much closer resemblances between the domesticated and the wild forms in the Old World suggest that domestication has taken place more recently. Thus the biological factors indicate a greater antiquity of agriculture in America.

Unity of American Agriculture

Among the historians and ethnographers various opinions have been held regarding priority of civilization, as between Mexico and Peru. Probably

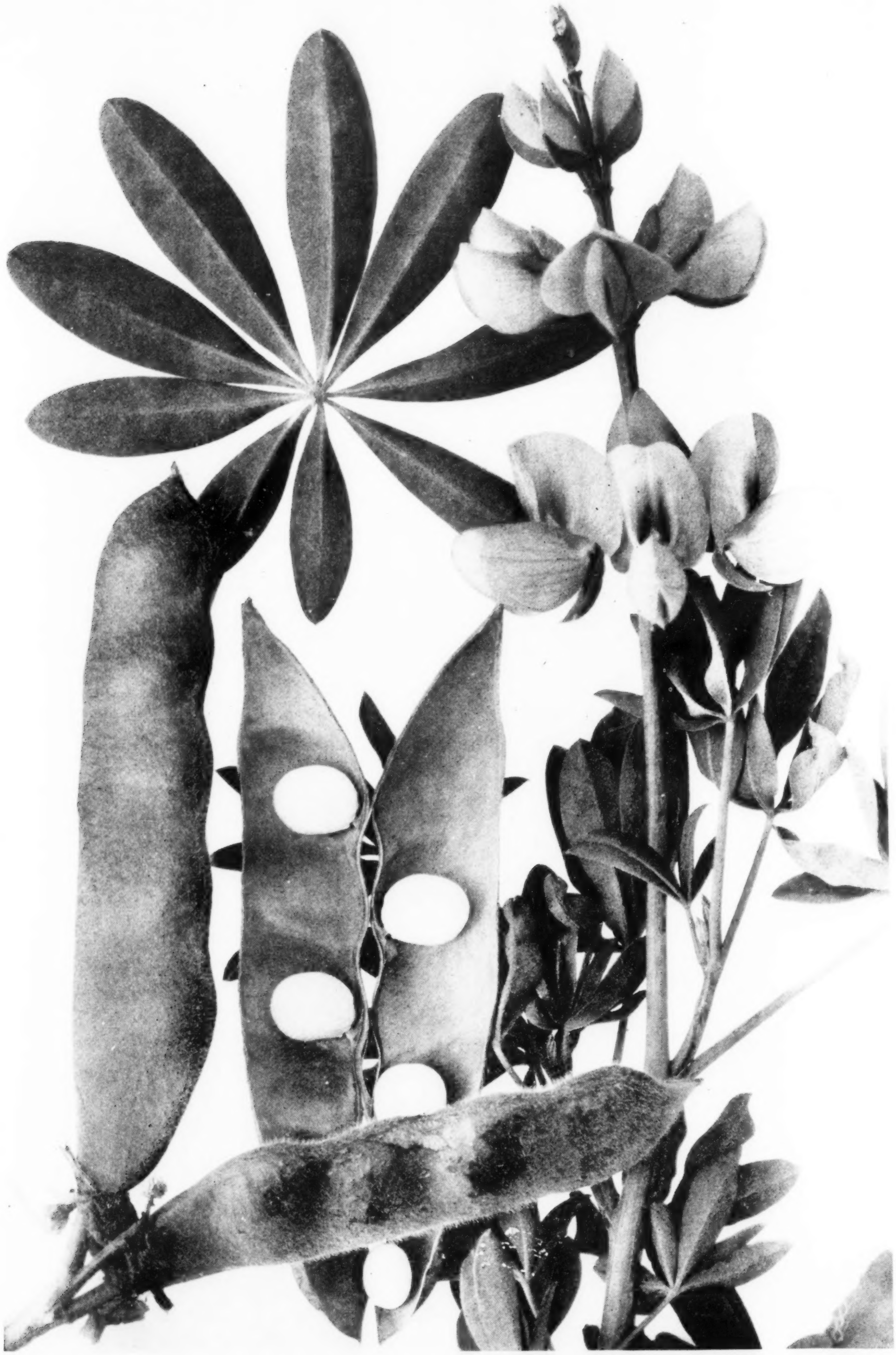
*See Trans-Pacific Agriculture, *Science* N. S., Vol. XLVI. No. 1192, page 435, November 2, 1917.



A SEED-BEARING CASSAVA

Figure 7

Fruits and seeds of the cassava plant (Manihot), a very important and widely distributed tropical root-crop. Since most of the varieties are seedless like other plants grown for long periods from cuttings, the finding of this seed-bearing variety, both spontaneous and cultivated, may indicate the persistence of a wild type in the eastern valleys of Peru.



A CULTIVATED LUPINE

Figure 8

A handsome blue-flowered lupine called "tarhui," probably *Lupinus cunninghamii,* is cultivated in the temperate valleys around Ollantaytambo. The seeds are eaten, but require special preparation which includes soaking in water for eight days to remove a poisonous principle.

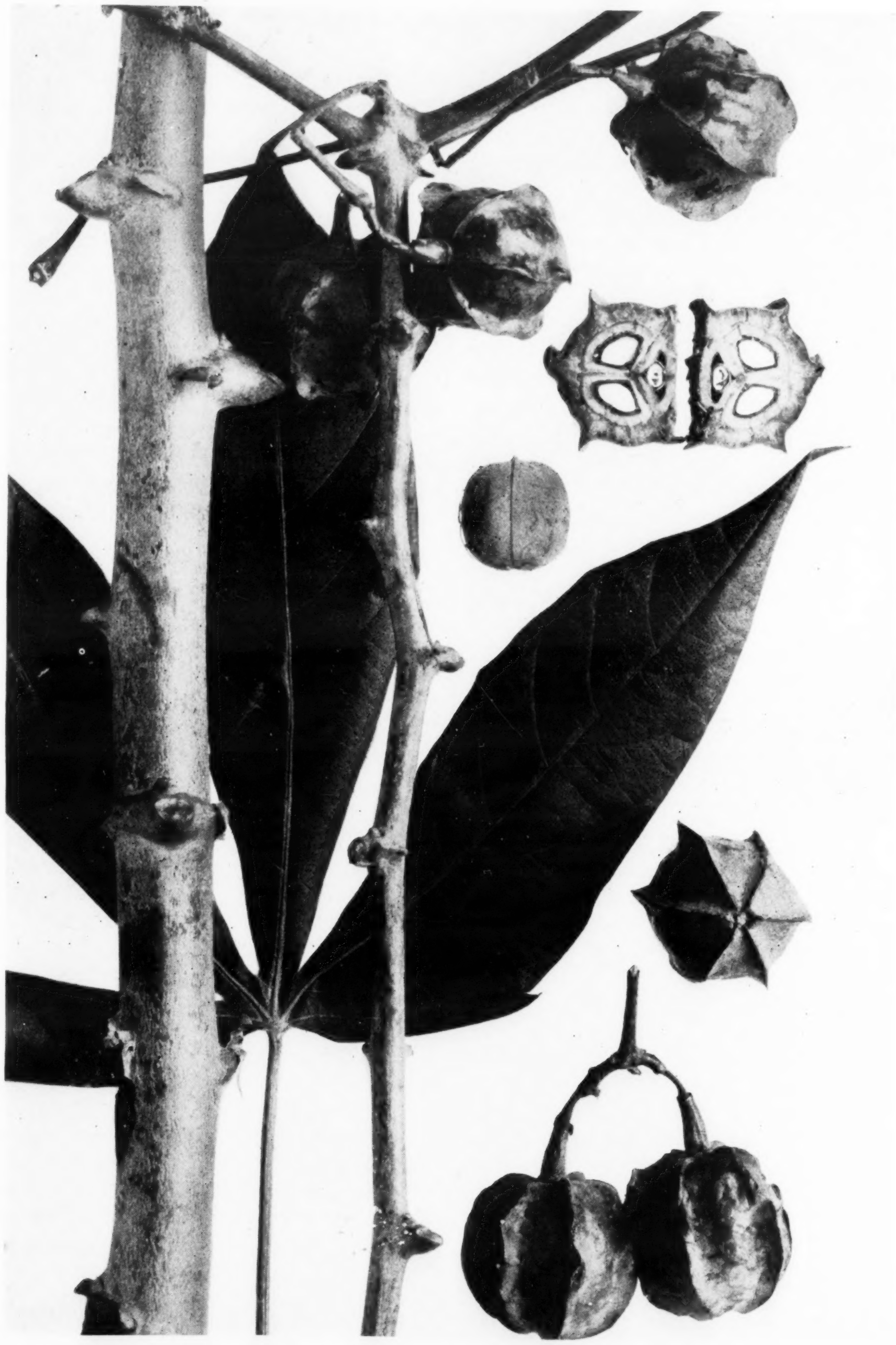


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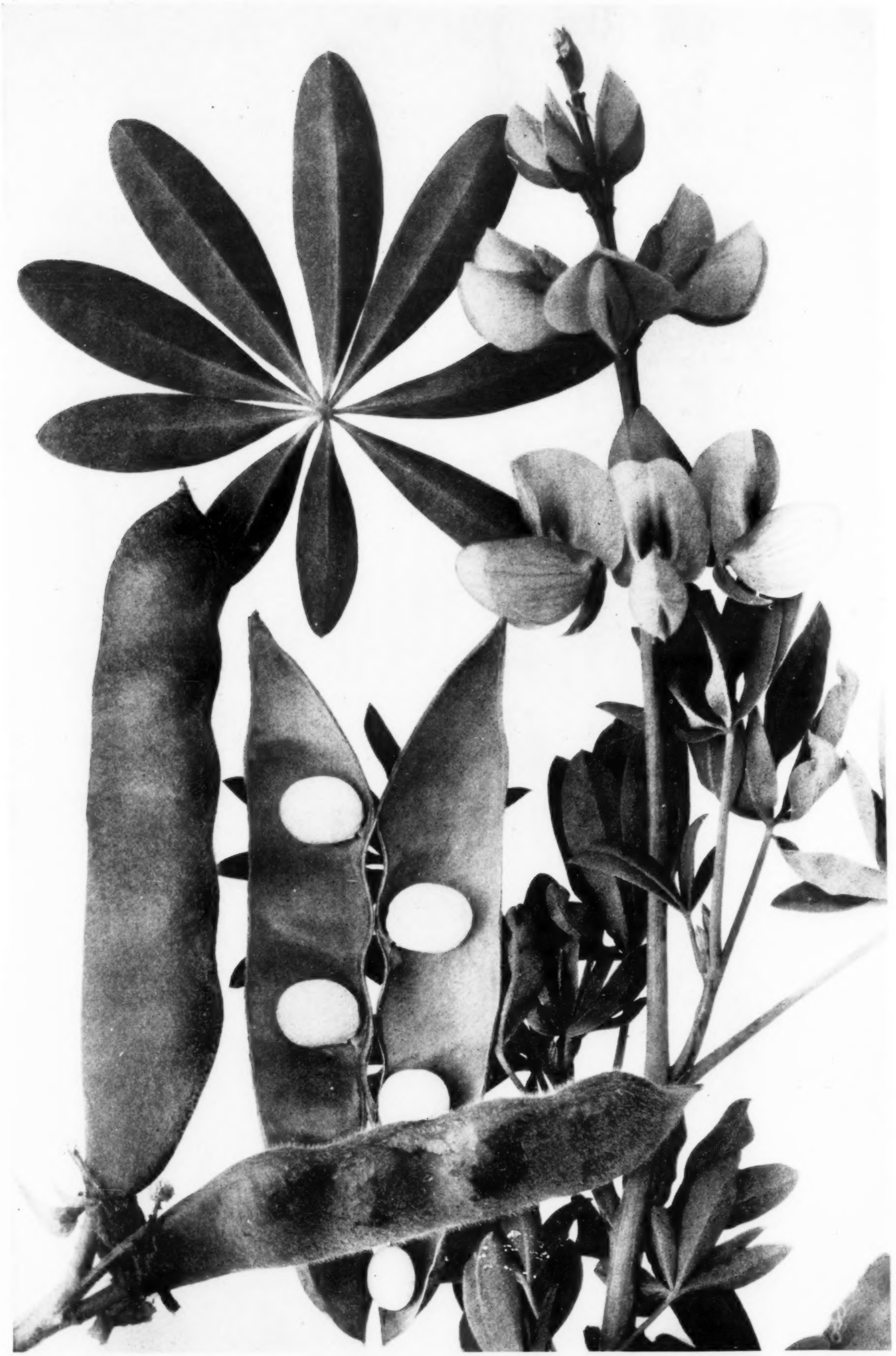
Figure 7

Fruits and seeds of the cassava plant (Manihot), a very important and widely distributed tropical root-crop. Since most of the varieties are seedless like other plants grown for long periods from cuttings, the finding of this seed-bearing variety, both spontaneous and cultivated, may indicate the persistence of a wild type in the eastern valleys of Peru.



A CULTIVATED LUPINE

Figure 8

A handsome blue-flowered lupine called "tarhui," probably *Lupinus cunninghamii,* is cultivated in the temperate valleys around Ollantaytambo. The seeds are eaten, but require special preparation which includes soaking in water for eight days to remove a poisonous principle.

HOW THE ANCIENT TERRACES WERE BUILT

Figure 9

A ruined terrace below the "citadel" at Ollantaytambo with the retaining wall partly fallen, exposing at the right the two layers, showing the artificial placement of the soil when the terrace was constructed. The upper layer of fine soil is from two to three feet thick, and under it is a deeper layer of coarse rubble. The right-hand part of this illustration is from the *National Geographic Magazine.*

the weight of opinion has inclined toward Mexico, because there a more advanced stage of civilization is supposed to have been reached. The exuberant development of architecture in the ancient Maya cities, the elaborate calendrical system, and the close approach to an art of writing, are features that have attracted much attention to the Mexican region.

Of Peru it may be said that the art of agriculture was more highly developed, the social system more advanced, and religion less barbarous. As an alternative of the graphic art, the Peruvians developed and used extensively a method of making numerical records with knotted cords, known as *quipus*. An elaborate calendrical system was not needed in Peru because the seasons were determined by a method of direct observation.

More important than to appraise the special attainments of Mexico and Peru is to recognize the underlying fact that in both countries agriculture was based on the same plants, so that the prehistoric agriculture of America may be considered as a single system, developed from a primary center of domestication. In Mexico, as in Peru, the chief food product was Indian corn, or maize, and many other plants of the lower Peruvian valleys were cultivated throughout tropical America, including Mexico, as sweet potatoes, cassava, xanthosoma, gourds, squashes, peppers, beans, peanuts, tobacco and cotton. That the same series of crop plants should attain such a wide distribution shows that many migrations took place and that many contacts were established. Food habits are very persistent and not readily changed. Wherever it is possible to do so, people will carry with them the food-plants to which they are accustomed, instead of domesticating new plants or adopting new foods.

Location of Maya Civilization

How the prehistoric contacts or communications were made between Peru and Mexico is a question that ethnologists may determine. The specialized worship of maize gods among the ancient Mexicans, and the many traditions of the coming of maize among the more northern tribes, are indications of an imported culture. Two lines of communication from Peru to Mexico are suggested by facts already known. Archaeologists now recognize in Central America the remains of pre-Maya cultures which may connect with South America by way of the Pacific coast or the Isthmus of Panama, while the distinctive Maya culture may have entered by way of the Caribbean Sea or the West Indies. The pre-Maya period is characterized, for example, by hollow-legged pottery, while the Maya pottery and stonework show elaborate headdresses, facial mutilations and tongue-boring that suggest Carib relations. The Mexican culture-deity, Quetzalcoatl, is alleged to have come from the East. Carib and Arawack tribes like those of the West Indies are widely scattered in South America, across the entire Amazon basin, from the Andes to the Guianas. The ancient seats of the Maya culture have been located through Morley's researches. The earliest dated monuments are in the lowland forests of the Peten district of Guatemala, not in the salubrious tablelands or the Pacific coast districts where historians and geographers have assumed that the Mexican civilization must have developed.

If any weight is to be given to the reasoning that many writers have followed regarding effects of environment, an indigenous development of the Maya culture in the eastern lowlands must appear improbable. In the light of present knowledge of Maya-land, it is interesting to review the argument of Squier, the chief historian of Central America published in 1858:

> The geographical and topographical features of all countries have had, and always must have, an important and often a controlling influence upon the character and destiny of their populations. The nature and extent of this influence receives a striking illustration both in the past and the present

Coarse Pubble. The right-hand part of this illustration is from the National Geographic Magazine.

condition of Central America. At the period of the discovery, it was found in the occupation of two families of men, presenting in respect to each other the strongest points of contrast. Upon the high plateaus of the interior of the country, and upon the Pacific declivity of the continent, where the rains are comparatively light, the country open, and the climate relatively cool and salubrious, were found great and populous communities, far advanced in civilization, and maintaining a systematized religious and civil organization. Upon the Atlantic declivity, on the other hand, among dense forests, nourished by constant rains into rank vigor, on low coasts, where marshes and lagoons, sweltering under a fierce sun, generated deadly miasmatic damps, were found savage tribes of men, without fixed abodes, living upon the natural fruits of the earth, and the precarious supplies of fishing and the chase, without religion, and with scarcely a semblance of social or political establishments.

It is impossible to resist the conviction that the contrasting conditions of these two great families were principally due to the equally contrasting physical conditions of their respective countries. With the primitive dwellers on the Atlantic declivity of Central America, no considerable advance, beyond the rudest habits of life, was possible. . . . Civilization could never have been developed under such adverse conditions. It can only originate where favorable physical circumstances afford to man some relief from the pressure of immediate and ever-recurring wants—where a genial climate, and an easily-cultivated soil, bountiful in indigenous fruits, enables him not only to make his permanent abode, but to devote a portion of his time to the improvement of his superior nature.

Such arguments appear logical and are still being elaborated by geographers, but often prove too much, as in the present case. The Maya civilization did exist and was maintained for centuries under the tropical low-land conditions that appear so adverse. The ancient low-land civilization gave rise to the table-land civilizations, and also was more advanced, or at least more specialized. As so often happens, the logical and the biological reckonings do not coincide. The biological factors dominated the environmental factors. Human ability and organization achieved the "impossible" in the prehistoric ages, as they do to-day. Our own civilization has still to understand and appreciate, if not actually to imitate, some of the achievements of the primitive and prehistoric peoples.

(Concluded in the March Number)

Annual Business Meeting of the Association

On Thursday, January 8, the annual business meeting of the Association was held at the offices of the Association in the Victor Building, Washington, D. C.

Reports by the Secretary, the Treasurer, and the Managing Editor were presented. It was shown that the income for the year 1924 was larger than for any preceding year, and that a greater proportion of this was obtained from dues and from the sale of back numbers than at any time in the past.

Messers. David Fairchild, Vernon Kellogg, O. F. Cook, and Frederick Adams Woods were elected to the Council for the ensuing term of three years.

The annual meeting of the Council was held on the following Tuesday, when the officers for the past year were elected to succeed themselves. The question of awarding the Meyer Medal for 1925 was discussed but no action was taken.

AGE OF PARENTS AND ORDER OF BIRTH IN RELATION TO LONGEVITY OF OFFSPRING

S. J. Holmes and I. Wilson
University of California

THE relation of age of parents and order of birth to the longevity of the offspring has been the subject of several studies but it still remains in doubt what conclusions should be drawn from the evidence in hand. It is not our intention to review the literature on this topic, but there are two studies which we wish to mention especially since they afforded the occasion for the investigations described in the present paper.

One of these is a study by Beeton and Pearson[1] on the relative duration of life of elder and younger siblings of the same sex. From an investigation of 2247 pairs of brothers and 1606 pairs of sisters it was concluded that the earlier born siblings had the greater expectation of life and that this expectation became greater if the interval between the births of the siblings was increased. "A brother born ten years before another brother has probably seven years' greater duration of life; a sister born ten years before another sister has about six years greater duration of life."

The other study referred to was made by Mr. Caspar Redfield on the relation of the duration of life of offspring to the age of parents at the time the offspring were conceived.[2] Redfield believes that old parentage, in addition to its other advantages, confers greater length of life upon the offspring. He finds that "sons of old fathers live longer than sons of young fathers," but he admits that there may be a source of error involved in his data since "it may be argued that the sons of old men are necessarily the sons of long lived parents, while sons of young men are the sons of both long lived and short lived parents, and consequently cannot be expected to live so long on an average." To obviate this objection he selected from the Redfield genealogy, "every family which had four or more sons who reached maturity and who did not lose their lives because of war or accident." The result was that "the average length of life of the fourth surviving son is more than ten years greater than the average life of the eldest surviving son."

These results are apparently inconsistent with those of Pearson, who finds that the advantage of greater longevity accrues to the earlier born members of the family, Redfield gives no data as to how many instances his conclusions were based upon and it was thought desirable to verify his results. A copy of the Redfield genealogy having been procured after some difficulty, a list was made of all families which had four sons who reached maturity and died a natural death. The great majority of families failed to produce four or more sons who lived to be of age. A considerable number of families had to be thrown out because several of the sons were living when the genealogy was published (i. e., 1860) and it was impossible to ascertain their natural span of life. Altogether the whole genealogy failed to furnish more than eight families which fulfilled the specified conditions. We could not verify Redfield's exact figures, but these families did show a gradual increase in

[1] *Biometrika* 3:30-89. 1921.
[2] Control of Heredity. Chicago, 1902.

TABLE I. Average Ages at Death of Offspring According to the Ages of Their Parents When the Offspring Were Born.

AGE OF MOTHERS

AGE OF FATHERS	under 20	20-25	25-30	30-35	35-40	40-45	45-50	Right Hand Column—Average Age of Offspring According to Age of Father at Time of Conception
under 20	4 52.7	5 34	3 32.7					39.9
20-25	26 52.9	51 51.6	20 55.8	5 42.8				51.4
25-30	20 57.8	87 51.3	77 55.3	31 55.8	2 45.5			53.7
30-35	13 42.4	58 52.8	69 53.3	67 54.3	17 46.8	1 50		52.4
35-40		30 54.8	59 56.1	49 55.9	44 59.3	8 53.0		56.2
40-45	2 32	15 50.5	22 55.5	30 49.7	33 58.8	17 50.6	2 69	52.3
45-50	4 56.5	7 56.3	20 56.45	24 55.5	18 54.9	5 67.6	1 47	56.5
50-55		5 59.8	7 49.7	19 50.8	17 47.8	3 68		51.6
55-60	2 54	2 43.5		5 58.6	7 52.8		1 20	51.6
60-65		3 68.3	2 31.5		1 56			54.1
65-70		2 40.5	5 51.4		1 58			49.6
70-75				2 36				36
75-80				1 34				34
	52	52.06	54.7	53.6	55.14	55.2	51.2	

Bottom Line— Average Age of Offspring According to Age of Mother at Time of Conception

longevity from the first to the fourth son, as Redfield has stated. It is quite unnecessary to comment on the absurdity of basing any conclusions on such a very small number of cases. Moreover, if we consider the age of the fifth son, which should be greater than that of the fourth, we find a marked drop from over 70 to 46.2. There were, it is true, only four such cases, but if we base conclusions on only twice as many instances it would scarcely be consistent to omit these facts. It was assumed that Redfield's cases of boys dying below twenty-one years were not included in assigning the ordinal ranks of those over that age. If we consider the younger members in such an assignment the distribution of the average ages at death of those over twenty-one becomes changed. The order of increasing age becomes 2, 1, 4, 3, instead of 1, 2, 3, 4, and if we include as many as seven sons who arrive at maturity the order of increasing age at death becomes 5, 2, 1, 6, 7, 4, 3. It is quite obvious that the test made by Redfield is worth absolutely nothing from a statistical standpoint.

Mr. Redfield seems to have felt the desirability of further data on this question for he says: "To test this matter still further I took some fifteen or twenty different family genealogies and abstracted from them every family in which four or more children lived to become adults. In doing this I made no discrimination between sons and daughters, but took all that came and tabulated them for birth-ranks and length of life. From 1,104 persons thus selected, and among whom those having high birth-ranks were the brothers and sisters of those having low birth-ranks, it was found that there was a very uniform increase in length of life as birth-ranks grew higher."

As Mr. Redfield makes no mention of the particular genealogies that were used, means of verifying his results are lacking. This, however, is not a matter of much importance as a parallel study may be made from other genealogies. The source of data which we have chosen was Allstrom's *Dictionary of Royal Lineage*. This gives most of the known facts regarding the births, deaths, and parentage of the royal families of Europe from the earliest times. A selection was made of all those royal families in which four or more members lived to be twenty-one or more years of age, and died a natural death. A tabulation was made of the average length of life of the offspring in relation to the ages of the parents when the offspring were born. In Table I we have arranged the ages of the mothers at the time of birth of children along the upper horizontal line and the corresponding ages of the fathers along the vertical line at the left. The average longevity of the offspring represented in the squares is thus tabulated in relation to the ages of both parents at the time the offspring are born. The upper number in each square indicates the number of cases upon which the average age of the offspring, represented by the lower number, is based. Thus when the father was less than twenty and the mother was also less than twenty the four children who lived to be over twenty-one had an average longevity of 52.75 years. It will be seen by consulting the figures at the right of the table, which give the general average ages at death of offspring grouped according to the ages of the fathers, that there is no manifest tendency for the children of old fathers to live longer than the children of young fathers. There is likewise no obvious tendency for the offspring of old mothers to live longer than the offspring of young mothers. Taking a given age group of one parent and considering the relation of longevity to the increasing age of the other parent, there is no consistent observable effect of age. So far as the data go they indicate that neither the age of the father nor that of the mother at the time of conception has any manifest effect upon the longevity of the offspring.

A separate study of the same material was made on the relation of longev-

ity to order of birth. We computed the average ages at death of the first, second, and subsequent born members of families which had four or more children who lived to be over twenty-one years of age. As in the preceding compilation, individuals less than twenty-one years of age were not considered. In Table II the birth rank is given in the left hand column, the number of cases of first, second, etc. born children is given in the middle column, and in the column at the right is given the average duration of life of the offspring belonging to the several birth-ranks. It may be readily seen that there is very little relationship between order of birth and longevity. The results, so far as they go, are equally inconsistent with those of Redfield and those of Pearson. It might be urged that our negative results are due to the fact that our data are based on royal families while those of Pearson and Redfield deal with ordinary humanity or more or less diverse social and economic status. For our purposes royalty has several advantages over the rank and file of people in general, on account of the fact that there would be little correlation between lateness of marriage and status, or between size of family and those extraneous influences which cause the sizes of families to vary so greatly in the general population. While royal families may be voluntarily limited like other families the inequalities of the limitation are probably not so great as among people of diverse social and educational advantages. Our results are based on a selected group of families of more than the average size, but this selection was made in order to obtain material that might be comparable with that employed in other studies. An investigation of all of the royal families and all of the individuals born to them might show a different relation between longevity and parental age. Such a study is now in progress and will form the subject matter of a later and more extended communication.

TABLE II.

Longevity according to birth rank only. No attention is paid to ages of either parent at the birth of the child.

Birth Rank	*No. of Cases*	*Average Age at Death*
1	(264)	51.6
2	(257)	52.4
3	(266)	50.6
4	(253)	54.2
5	(214)	51.9
6	(173)	53.4
7	(115)	54.1
8	(88)	50.5
9	(77)	47.0
10	(50)	55.2
11	(30)	50.5
12	(26)	56.4
13	(15)	56.8
14	(11)	48.7
15	(7)	53.1
16	(5)	51.8
17	(2)	41.0
18	(2)	47.0

In this table only those cases were used where there were at least 4 children in each family that lived to adult age (21 years). No cases were used of those accidentally killed.

Back Numbers of the Journal of Heredity Wanted

Numbers listed below should be mailed to the office of the Association, Victor Building, 724 Ninth St. N. W., Washington, D. C., and will be paid for at the prices indicated. Unless payment in cash is requested, members' accounts will be credited with the amounts due for the Journals received from them.

Vol. V, Nos. 1, 4 and 7, 50c.
Vol. XI, Nos. 2 and 4, 30c.

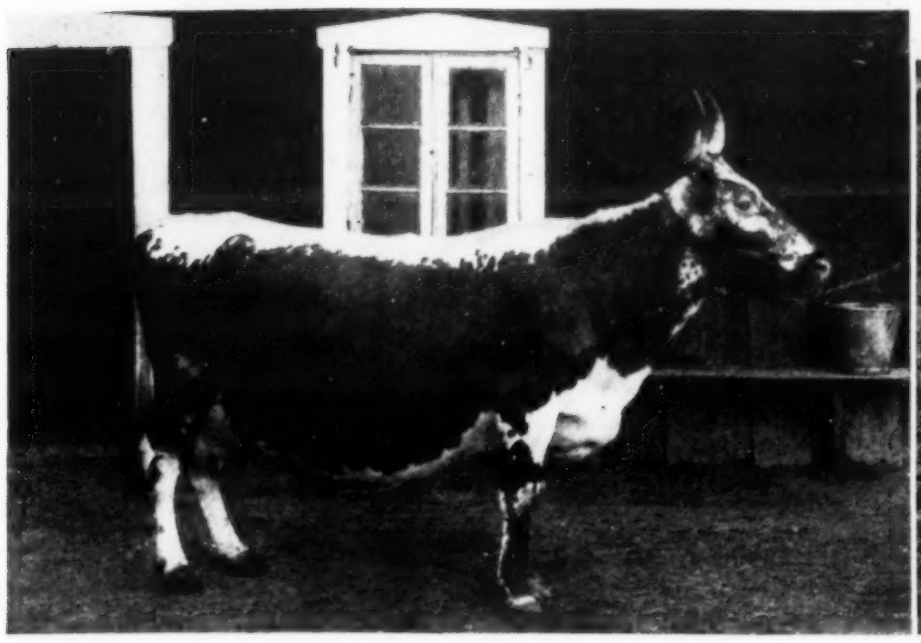
American Breeders Magazine:

Vol I, No. 3, 50c.
Vol. II, No. 1, 50c.
Vol. III, No. 4, 80c.
Vol. IV, No. 3, 50c.

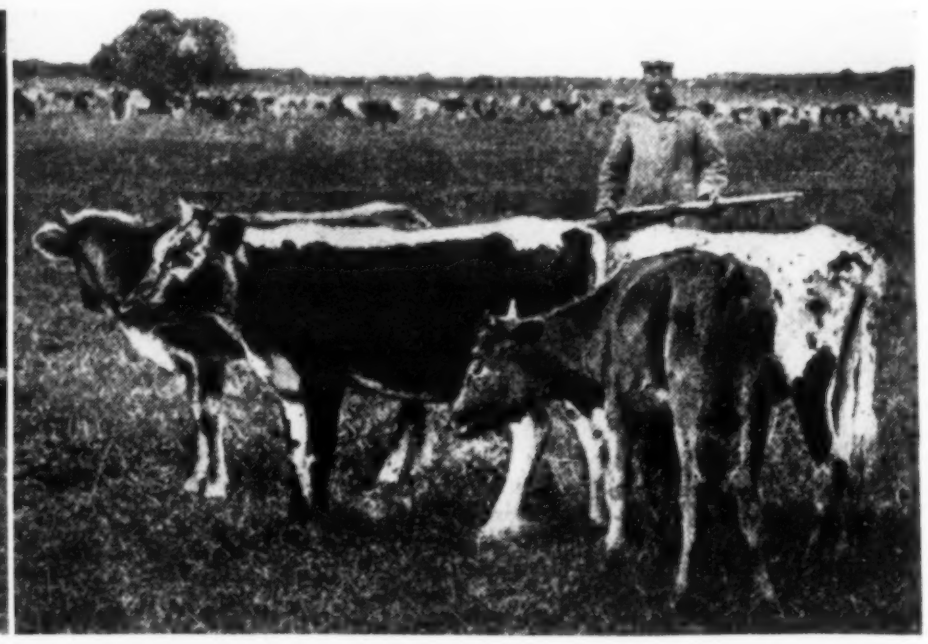
COLORSIDED CATTLE

Some Remarks Concerning Their Occurrence and Heredity

CHRISTIAN WRIEDT
Department of Agriculture, Ski, Norway



TELEMARK COW
Figure 10



RUSSIAN COLORSIDED HEIFER
Figure 11

The Telemark breed has the typical "colorsided" pattern, which is found in many breeds in Europe, and in at least two other species of the Bovidae—Zebu cattle and Yaks. This pattern is incompletely dominant to the unicolored (self) condition.

A NUMBER of types of white patterns are found in cattle. The pied pattern of Ayrshires, Holstein-Friesians and other breeds have been demonstrated to be recessive in respect of uni-coloring. Gowen has found, however, that there probably occurs in these races a dominant hereditary factor in respect of white marks round the eyes. Boyd and Nabours have proved that the white head in Hereford cattle is dominant. The same was found by Richardson in the Westerwald cattle.

The belted pattern in Holstein-Friesian cattle has been investigated by Kuiper and Houvink who found it to be incompletely dominant in respect of uni-coloration.

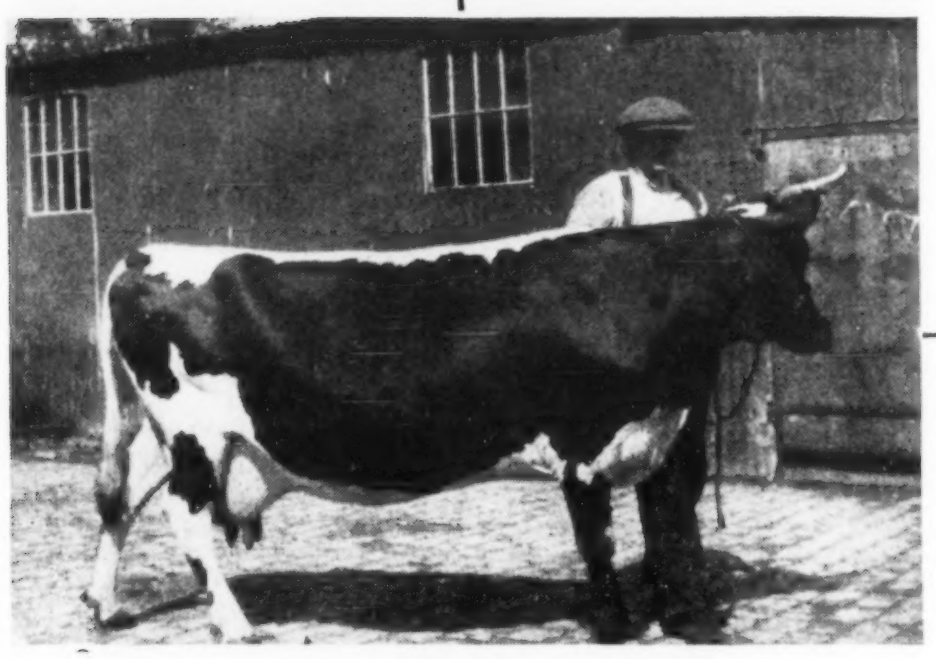
In the colorsided pattern the croup, back, neck, dewlap, underside of chest, belly and udder are white (Figure 10). Also a white band often occurs across the foreleg and white marks on other parts of the legs are also common. As a rule the tail is white. The forehead as a rule is found to be white with colored dapples (Figure 11).

Distribution of the Pattern

These marks are found in the Telemark breed, the colorsided Troender cattle, and the North Country cattle in Norway, in the East Finnish cattle, in Longhorn cattle in England, and in the Vosge cattle in Alsace Lorraine. By Lydtin and Werner this pattern was found frequently in the German breeds of Bavaria, the Hinterwald, the Vorderwald, and the Sudeten breed. The same pattern also occurs sporadically in the cattle of other countries.

Thus in a photograph from the Jubilee Exhibition at Konigsberg in 1913, a colorsided cow is depicted as a representative of the old local race of Eastern Prussia, and Grundtmann mentions that the old local race of cattle in the Erzgebirge was colorsided. The cow which he had chosen for an illus-

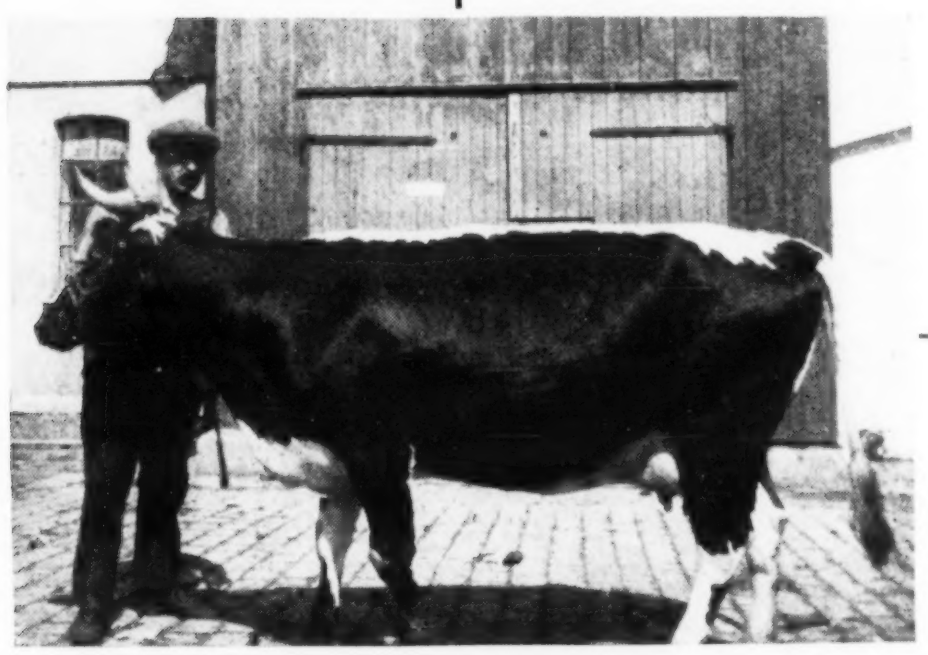
TELEMARK × HOLSTEIN-FRIESIAN



Cow 13

× HOLSTEIN-FRIESIAN

(This mating also produced two pied animals, Nos. 8 and 17 (See Figures 15 and 17).



Cow 42

× HOLSTEIN-FRIESIAN

Cow 76

× HOLSTEIN-FRIESIAN

Colorsided Heifer

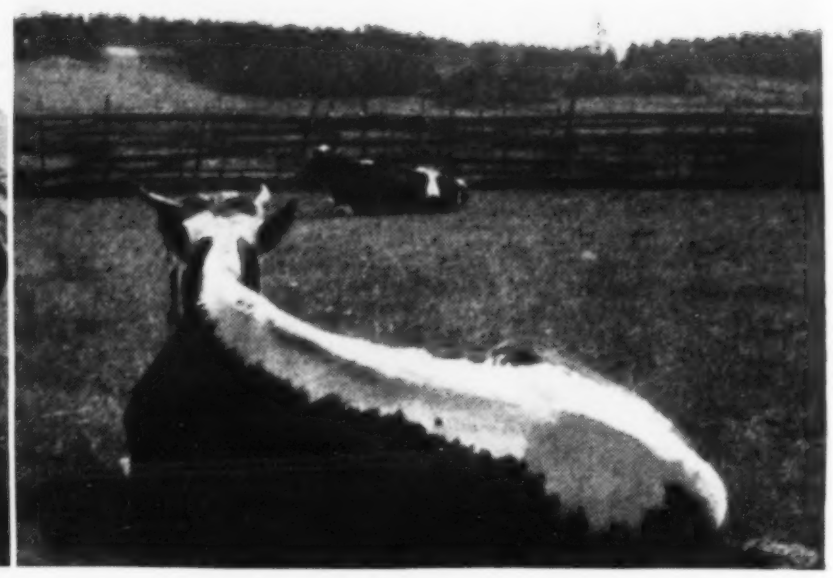
INHERITANCE OF THE COLORSIDED PATTERN

Figures 12, 13 and 14

A first generation cow and two generations of back-crossing on the Holstein-Friesian are shown. In the third generation backcross a typical colorsided heifer was produced.

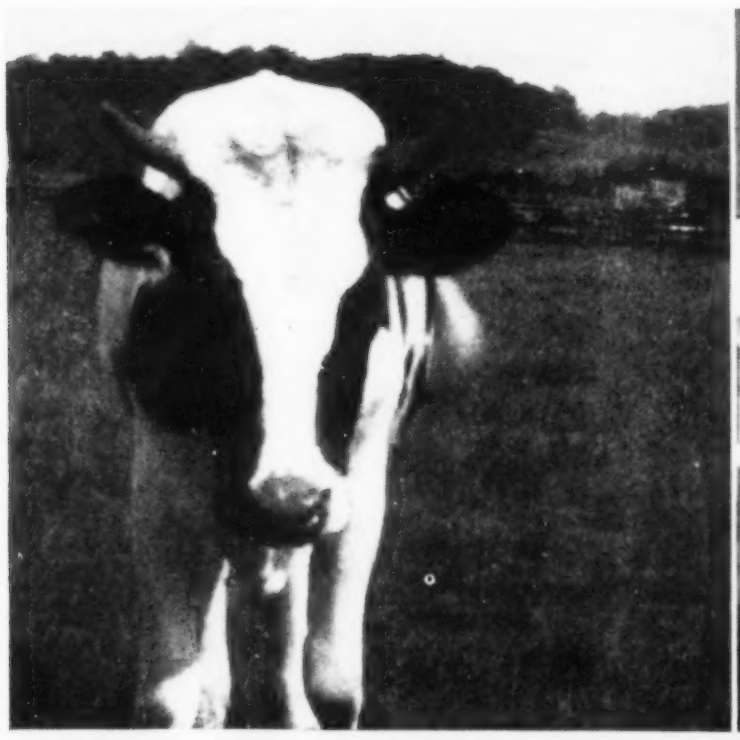
A CROSSBRED HEIFER
Figure 15

This heifer is a full sister of cow No. 42 (Figure 13).



THE "SPINAL STRIPE"
Figure 16

Back view of No. 76 (Figure 8), showing the band of white down the center of the back.



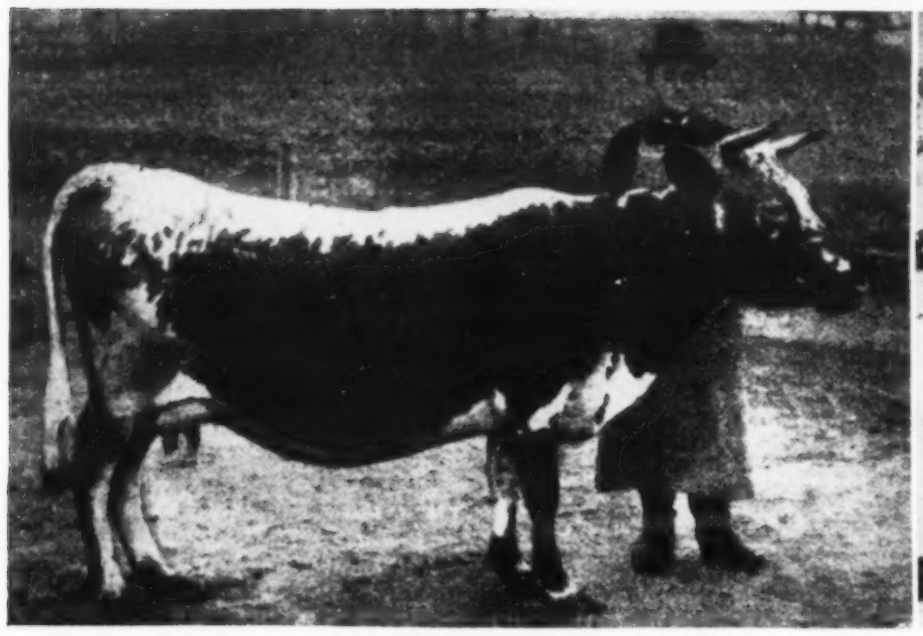
HEADS OF CROSSBRED COWS
Figures 17 and 18

Left, head of Heifer No. 71 (Figure 17); *right,* head of No. 42 (Figure 13), showing dappled head typical of the colorsided pattern.

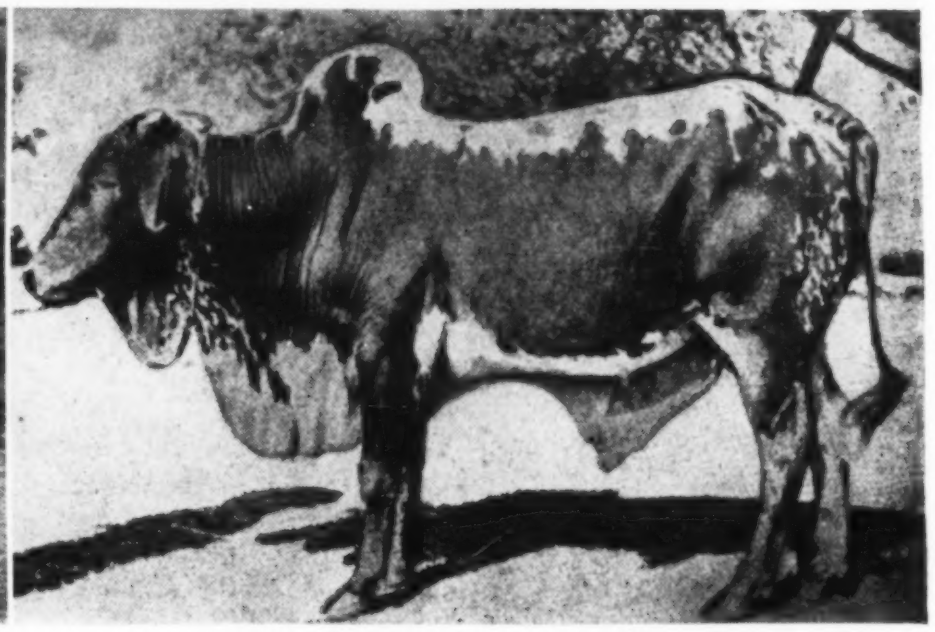
tration, is as the figure shows, a characteristically colorsided cow (See Figure 19). Hofmann mentions that colorsided cattle existed in the province of Seeland in Holland. Stakemann in his article on Russian cattle gives a picture of two colorsided bulls and a colorsided heifer (Figure 11). Richter gives an illustration of draught bullocks from the Balkans, and these also must be characterized as colorsided. Antonius has a photograph of an African Betschuan bullock which is colorsided with extreme white and with distinct dapples on the head

In the Kuhlander cattle in Moravia, colorsided animals with white heads frequently occur. This pattern is probably due to the fact that the factor for colorsided is present together with other factors for white pattern. On the other hand, in my opinion it is improbable that the white croup, the white back and under side together with wholly colored neck and head in the Pinzgau cattle are due to the same factor as the colorsided in the breeds here mentioned.

The dappled spots of color which occur, especially on the heads of these



COW FROM ERZGEBIRGE
Figure 19
After Grandtmann



MONTGOMERY ZEBU BULL
Figure 20
After Muller

breeds, are not found in the Pinzgau cattle, and the facts which follow make it probable that it is the same factor that causes the colorsided pattern and the dappled coloring in the Telemark cattle.

Pitt has demonstrated in Hereford cattle the existence of a recessive factor for white back and croup. This factor, which is recessive in respect of color, the latter factor showing a clear dominance.

The Colorsided Pattern in Other Bovidae

It is of special interest to note the existence of a colorsided Zebu with pattern exactly corresponding to those in the Telemark cattle and other breeds, as shown by the illustration here given after Muller (Figure 20).

Colorsided yaks are found showing a great similarity to the pattern in the Telemark breed, but in the one and only colorsided yak I have had an opportunity of seeing there were no dappled marks on the head. Brandt, who has elaborated the posthumous notes of Kuehn on the crossbreeding of yaks and cattle, came to the conclusion that the colorsided pattern in the yak is incompletely dominant to unicolored. This would be in accord with the facts concerning the occurrence of colorsided cattle.

The fact that the same kind of marks are found with certainty in two and probably in three species of the bovidae is of great interest when compared with the numerous various parallel mutations demonstrated in the *Drosophila* species and in rodents.

Inheritance of the Colorsided Pattern

With regard to the heredity of the colorsided pattern I have had an opportunity of collecting a few facts which are given below as a preliminary report.

As regards crossing of colorsided and unicolored animals I have had an opportunity of observing eleven from red polled cattle mated with Telemark cattle, three by a red Troender bull mated with colorsided Troender cow, and four by an Aberdeen-Angus bull mated with Telemark cows. All these animals had colored necks and heads, white undersides and spinal stripes (Figure 21), which sometimes reached forward to the withers, but in other cases were limited to the croup.

Of backcrosses to unicolored animals I have had an opportunity of seeing several, but I have not been able to obtain detailed notes concerning them. Among these backcrosses there were both unicolored animals and colorsided ones, of the same type as the F_1 animals already mentioned.

Among the Norwegian unicolored breeds which to a great extent have

SKIN OF A HYBRID TROENDER CALF

Figure 21

This calf was a first generation hybrid between a unicolored and a colorsided animal. Note the partial dominance of the colorsided pattern.

been crossed with colorsided, I have found no colorsided offspring from unicolored parents, nor have I ever heard of such an occurrence.

Of cross-breeds between colorsided cattle and various kinds of pied breeds I have had an opportunity of observing crosses from red pied Swedish with Telemark, and one from Holstein Frisian with Telemark. The strain of red pied Swedish cattle which was used had very little white color, the white pattern being restricted to the under side of the chest and belly. The two bulls used had this pattern. From one bull, the *Hero,* I have seen ten offspring. They all had a white spinal stripe up to the withers, white dewlap, white under side of the chest, white belly and white udder. Further they had white spots behind the ears and at the back of the root of the horns. From the other bull, *Brage,* I saw four offspring, of which three had the same marks as the offspring of *Hero,* whilst one had a spinal stripe on the croup only. There were, however, white spots at the back of the root of the horns.

Of back-crosses with Telemark I saw nine animals of which three were like the F_1 and six were regularly colorsided, as Telemark cattle. Of backcrosses to the red pied breed there was one, which was marked like the F_1.

Of cross-breeds from Holstein-Friesian with Telemark I have had opportunity of seeing four. They were all regularly colorsided. One of the F_1 cows was backcrossed with a Holstein-Friesian bull, had three daughters, of which one was typically colorsided and the others had the typical spotted pattern of the Holstein-Friesian breed with no trace of any dappled marks in the forehead.

The colorsided cow from the backcross was again backcrossed with another Holstein-Friesian bull, and the result was a typically Telemark marked heifer, and this heifer had in a third back-cross given a typical Telemark marked calf.

Both from Norway and from Finland I have several times received information that colorsided cattle, when intercrossed, frequently produce ordinary pied offspring.

The facts stated in the above, in connection with the circumstance that the colorsided occur in so many breeds of cattle, make it exceedingly probable that this pattern is caused by one single Mendelian factor, which is incompletely dominant over unicoloration and the here mentioned pied pattern in the red pied Swedish breed, and completely dominant over the ordinary spotted pattern of the Holstein-Friesian.

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Problems of Citizenship

Problems of Citizenship, by Hayes Baker-Crothers, director of the course in problems of citizenship, Dartmouth College, and Ruth Allison Hudnut. Pp. XIV +514. Price $2.75. Henry Holt & Co., New York, N. Y.

"Problems in Citizenship" is primarily a college text book for introductory courses to the social sciences. The contents should be of general interest, however, to all persons who are interested in sociology, economics and political science.

The subjects chosen for discussion might be classified roughly into three categories, namely: those questions such as the newspaper, the industrial problem, and the problem of civil liberty with which the large mass of people are daily concerned; questions of a racial character, such as the Negro problem; and questions of an international nature, such as immigration, international relations, and the problems of war and peace.

As might well be expected in a treatise of this kind, the authors have discussed the various problems in an unbiased manner and have refrained from drawing conclusions in cases where there may be a difference of opinion. For instance, the economic and social position of the Negro are fully discussed from the viewpoint of the white North, the white South and the Negro. It cannot be expected that the suggested remedies for the betterment of the Negro's position will be satisfactory to all three classes, and the authors are careful to point out that a satisfactory adjustment of the Negro problem does not give much promise of immediate success.

Space will not permit the discussion here of subject matter contained in "Problems of Citizenship." The benefits and the evils of immigration; the truths and fallacies contained in the newspaper, and causes and benefits of the strike, are all topics which the average citizen may read with profit. For those who wish to pursue any particular subject further, an excellent and extensive bibliography is given.

H. C. M

EDUCATION AND FECUNDITY

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THE PAPER by Professor S. J. Holmes that appeared in the October, 1924, number of the JOURNAL OF HEREDITY is of peculiar interest. He has given us important data bearing on the question of the changing birth-rate from a distinctly new angle of view. In most of the discussions that have appeared heretofore the statistics have been based upon the fecundity of the college students themselves. In Professor Holmes' work we have presented the situation as it exists in the families from which the college students have sprung. Such data will be of great value for comparison with the conditions that may be found to prevail in the next generation from these same college students. We may easily surmise what in general terms it will be.

His Table IV. dealing with the relation of family size to the parental education is unique and shows in a most striking manner the remarkably close correlation between the fecundity and the education of parents. The following tabular rearrangement of the final averages will make this more clear and bring out some interesting questions. The figures are the average number of children per family in the indicated matings from three types of education. For more complete details see the paper by Professor Holmes.

Ignoring for the present the category of "Means," we may observe that there is a decline of values in each horizontal series from left to right and in each vertical series from top to bottom, also in the diagonal series from upper left to lower right. In all these series the correlation is with the degree of biparental education. Theoretically the remaining diagonal, upper right to lower left, should give a series of approximately equal values since they represent the birth-rates of balanced matings. In reality they differ less in value than for any of the other series of matings. A slight irregular unbalance could be expected under the law of probability and would be of no significance. Curiously enough the tilting of the balance is distinctly, though slightly, in one direction and the series declines downward. This is evidently correlated with the relatively lower fecundity of the educated mothers as compared with the educated fathers noted by Professor Holmes. It seems evident that this series constitutes a delicate test of the reliability and sufficiency of the data.

Age of Marriage

Professor Holmes has suggested that the preponderance of the educated mother in determining "the family limitation" is to be accounted for by "the factor of age at marriage." Age at marriage is unquestionably a greater factor in determining fecundity in the female than it is in the male and it has been demonstrated that securing a higher education tends to delay the time of marriage. Unfortunately the present records do not provide data as to the age at marriage. We have not, therefore, means for actually measuring the influence of this factor as affecting these tables.

In studies made in England on "The Fertility of the English Middle Classes,"* in which special attention was given to the factors of age at marriage and duration, it was concluded that "paying attention to the errors of sampling, there is no difference between the average size of the

*BROWN, J. W., GREENWOOD, M., *and* WOOD, F. The Fertility of the English Middle Classes. *Eugenics Rev.*, 12: 158-211. 1920.

family of a non-college mother and that of a college mother which cannot be explained by difference of age at marriage and duration of marriage." In these studies the non-college mothers were the sisters and near relatives of college mothers and no differing factor was involved, presumably, except purely that of degree of education, and the conclusion seems to be justified that "the alleged prejudicial effects of higher education *per se* upon the capacity or inclination of women to bear children do not exist."

In consequence of the sources of the material in Professor Holmes' studies there is every reason to believe that it is less homogeneous than the English data. The different types of mothers were presumably not usually related and may have been from very different social strata. Is it, therefore, sufficient to suggest that "Relative youth rather than relative education may be the chief reason" for the closer association of the mother with family limitation?

Fecundity of High School and College Mothers

Let us again look at our table and consider now the series of "Means." Observe that these are computed from the original aggregates as given in Professor Holmes' tables and are not simply the means of the averages. From this series we may note that the mean number of children of a common school mother mated with all types of fathers is 4.03, for a high school mother mated with all types of fathers it is 3.38, a difference of .65, while a college mother mated with all types of fathers yields a birth-rate of 3.23 or only .15 less than the high school mother. In other words the decline in fecundity from the common school mother to the high school mother is over four times the decline from the latter to the college mother. To put it in another way, the high school mother is 16 per cent less fertile than the common school mother while the college mother is only 4 per cent less fertile than the high school mother. The same facts are evident also from the means of the fathers but in a less striking way, the differences being now 12 per cent and 5 per cent respectively.

Since a girl commonly completes her high school education by the age of 18 or 19 years there is no reason to suppose that the date of her marriage is on the average materially delayed by her high school course, or that her productivity is reduced even one per cent by a restricted period of bearing. It is the girl who goes through college or other higher institution whose reproductive powers may be affected by a delayed marriage. After making correction for duration of marriage, if we had the data for that purpose, it is highly probable that the difference between high school mother and college mother would be entirely negligible, if it is not practically so already, but the difference between high school and common school mothers would be in all probability undisturbed. It is not possible, therefore, that "relative youth" is an adequate factor in the solution of the problem.

College Education Not a Factor

The facts here brought out are further evidence against the unwarranted conclusions often so loudly proclaimed, that our colleges and especially the colleges for women are responsible for the sterilization of the race. From the data furnished by Professor Holmes it seems evident that if there is an educative factor involved in the problem of a declining birth-rate it is not operative through the higher institution, but is chiefly effective in or below the high school. It may not be amiss to remark that it is in the latter institution that our educational system is most closely in contact with the adolescent youth. It is between the parent of common school or less education and the one of high school education that there is an appreciable and perhaps significant difference in fecundity and this is in no way in-

volved with or modified by a question of delayed marriage.

Here is something that will bear further investigation, something that seems promising of fruitful research when adequate data is available. It is the writer's opinion that education, and especially formal college education has little or nothing to do with the declining birth-rate, that the correlations between education and fecundity which have been so greatly exploited are spurious or rather that they are simply mutual correlations with a *tertium quid* and are not directly related. If the data were available in respect to these same families as to the rate of income per head or some other measure of the social and cultural status, it seems probable that we would find an even more consistent correlation with fecundity than is now evident between fecundity and education. It is highly improbable that education in itself is sterilizing our population, and it is time we made search for other factors in the phenomenon. Professor Holmes is doing good service in getting the attention away from the educated individual to the "pit from whence he is digged."

TABLE I—Average Number of Children per Family, According to the Degree of Education of the Parents.

		FATHERS			
		Common School	High School	College	Means
MOTHERS	Common School	4.17	3.89	3.44	4.03
	High School	3.55	3.38	3.24	3.38
	College	3.35	3.14	3.10	3.23
	Means	3.94	3.46	3.27	

Civilization and Degeneracy

KULTUR UND ENTARTUNG, by OSWALD BUMKE, Professor in Leipzig. Second ed., pp. 125, price 85c. Berlin, Verlag von Julius Springer, 1922.

This is a study of dysgenics, by a psychiatrist. It reaches the conclusions (1) that degeneracy does not necessarily follow a high state of civilization and (2) that there are not marked evidences of degeneracy in the German nation at present. Much of the work is second-hand and uncritical, but the book contains a good deal of interest. There is a bibliography of 459 items.

P. P.

THE CAUSES OF CANCER

A Review

THIS is all, or almost all, a book* on such a grave subject ought not to be. Its whole substance is expressed in twelve words, the author's own; "In my opinion cancer is due to chronic poisoning and vitamine starvation."

In science we draw a sharp distinction between "opinion" and what has become *established fact.* The author repeats certain doubtful statements so many times that, finally, he forgets that they are his opinions and makes them do service as facts. He says: "I am fully acquainted with the latest discoveries," but a perusal of his book, which is wearisome from its repetition, shows that he is misinformed on many topics and ignorant of others.

The book contains some excellent advice on how to keep well, drawn from his own experience, along with many half-truths, loose statements, over-statements and unwarranted interpretations. For example, on p. 86, following a table, on which his statement is based, he says: "During the few years under consideration deaths (in the U. S.) from visible cancer * * have considerably more than doubled—a truly terrible record." Now, a study of the table shows nothing of the kind. He can extort from it such an unwarranted statement only be comparing the first year with the last year, or some other low year with a high one. If we make an average of the first ten years, the only safe way, and compare it with an average of the last ten years, his statement is seen to be wide of the truth. Here is what we then have:

SKIN CANCERS

1900-1909, av. deaths per year	1998
1913-1922, av. deaths per year	2286

BREAST CANCERS

1900-1909, av, deaths per year	4833
1913-1922, av. deaths per year	6136

BUCCAL CANCERS

1900-1909, av. deaths per year	1818
1913-1922, av. deaths per year	2460

To bear out his contention the figures of the last period should be 4,000, more than 9,666 and more than 3,636. This is only one of many examples. He is a babe in the woods when it comes to the use of statistics. He is also an alarmist, here and in many other places.

The book is neither a scientific treatise, nor a medical one. It is not even a popular account of cancer. It was written to exploit a theory. The author's assertion that cancer is due to chronic poisoning and vitamine starvation may be true, for aught I know, but nothing in the book establishes that hypothesis. If the author had set down only what he knows, experimently about cancer, he would have had nothing to say, and if he had confined himself to setting forth only the facts generally agreed upon among medical men, surgeons and physicians, his treatise would have been a thin primer, instead of a book of 500 pages.

The author speaks rather slightingly in various places of men who have devoted their lives to the subject and are working very hard in legitimate ways to determine the cause of cancer, thinks their experiments are of little value, fears they have lost their way, would like to direct their labors, etc. On the contrary, he grasps at every straw that seems to support his theory. The conceit of the man, in a strange field, without any background of scientific training and hardly able to

*Cancer: How It Is Caused; How It Can Be Prevented, by B. J. Ellis Barker, with an introduction by Sir W. Arbuthnot Lane, Consulting Surgeon at Guy's Hospital, London. New York, E. P. Dutton and Company. 1924.

reason correctly from premises is something colossal.

I submit nothing is gained by exalting the scissors and paste-pot (source of this book) at the expense of the men of science.

His final conclusion, Q. E. D., is that "The causation of cancer is *obvious*. The way to avoid the disease is equally *obvious*." The italics are mine. The book seems to be written from a profound conviction and with good intentions but so are many patent medicine advertisements.

Beyond doubt we shall eventually learn the cause of cancer and how to avoid it, but it will not be by making compilations from books.

The author's ideas are that cancer is a disease of modern life likely to increase enormously in the near future. It is due, he thinks, to bad eating and drinking and general bad hygiene, especially of the lower bowel.

The habits of the whole civilized world especially in cities, are absolutely wrong and likely to go from bad to worse. He advises against cane sugar, as a poison, all candy of course, all food out of tins, all strong condiments and hot drinks, all white rice and fine flour bread, all frozen meats, all meats treated with preservatives, that is, practically all fresh meats that come into cities, all meats that are cured, all processed foods, all Pasteurized milk, all milk treated with preservatives, all condensed and dried milk, all bleached foods, all jams and jellies containing preservatives. Constipation leads straight to cancer. He is obsessed with the idea that he himself is in a precancerous stage, is walking twenty miles week-ends, taking cold baths and filling himself desperately with all sorts of vitamines to ward it off, if possible. He warns against exposure to arsenic, even in the minutest quantities, but smokes tobacco and does not know that arsenic compounds are freely dusted on growing tobaccoes, and also sometimes on the leaves in the curing shed, to kill insect larvae.

What Do We Know About Cancer?

(1) It seems to be on the increase, but even this is disputed by some very competent statisticians, *e. g.*, Wilcox, who maintains that the apparent increase is not a real one but due to more careful reporting and better modern diagnosis.

(2) It seems to be an inheritable disease, judging from results obtained by inter-breeding cancerous rats, or mice. By this method, in both rats and mice, races 100 per cent cancerous have been obtained. It is denied by many that we can reason from mice to men, but in addition to the general laws of heredity, which apply to all living things, there is some reliable specific evidence that we may do so, *e. g.*, see statistics of cancerous families collected and published by Dr. Warthin of the Medical Department of the University of Michigan.

(3) Cancers almost always begin in irritated places. Even when there is a strong tendency to cancer it does not appear unless the irritant is there, as is indicated in experiments done on rat liver sarcoma at the Crocker Institute, Columbia University, N. Y. This tumor follows irritation due to the larvae of a tape-worm of the cat, but even in races of rats bred so as to be very suscepticle to the disease it does not occur unless the rats are fed on the eggs of the worm. The same holds good in stomach carcinoma of the rat, due to a nematode of the cock-roach.

(4) The general behavior of cancer would seem to indicate the presence of a parasite, but no parasite has been found except in some of the lower animals. The disease is one which the body cells locally (the cancer) are under a strong stimulus to division which the body as a whole is unable to control.

(5) The kinds of irritation leading to cancer in susceptible individuals seem to be numerous: tuberculous lesions, syphilitic lesions, scars of bad burns, woundings due to repeated

applications of arsenic, aniline, paraffine, etc. In recent years in many laboratories cancers have been produced by painting tar repeatedly on the skins of rabbits and mice. It is believed by many medical men on purely observational grounds that immoderate use of tobacco, alcohol, strong condiments and very hot drinks lead to cancer. Arsenic cancers are well known.

(6) It is generally agreed, at least among surgeons, that early operations offer the best hope of recovery, either with or without the use of radium and X-ray.

(7) In the precancerous dermatoses and in the milder forms of skin cancer, radium and X-ray alone in the hands of competent men have given remarkable results, some of which at least bid fair to be permanent cures, having passed the surgeon's five-year period without recurrence. The writer saw many such apparent cures at Buffalo in the spring of 1924 (Institute for Infectious Diseases).

What is needed now, most of all, is not more books of the type of this one, but abundant funds for unrestricted research. When we know the cause of cancer, it will have lost its terror and beyond doubt some means of avoidance will be discovered. Hundreds of earnest and well-equipped men are now working on all phases of the problem in all parts of the world, and, personally, I believe it is approaching solution. Certainly great progress has been made in recent years, but nearly all the laboratories need more money. Even a few thousand dollars to each of half a dozen I could name would be of very great service.

ERWIN F. SMITH,
President American Association for Cancer Research.

What Happened to the Pandanus Bud Sport?

In 1919, the writer reported a remarkable bud mutation in *Pandanus utilus* (JOUR. OF HEREDITY 10:376-378). The case was that of an old but small plant which changed suddenly, in 1917, from the typical three-spiral condition to a two-ranked condition with the spiral twist entirely absent. The plant continued thus until 1922, presenting in the meantime a great, broad, fan-like appearance. The trunk bearing the two-ranked leaves was finally about 2½ feet long, when just as suddenly as the original change, the bud went back to the rhythm of leaf development changed from the straight "two-step" to the stately "three-step" again. Was the change in the first place a change in heredity and in the second case an undoing of the new factor or group of factors; were some of the original factors "paralyzed"; or was there merely a change in the internal "environment" or physiological gradient which continued to cause the plant to develop as a "new species" for five years? It is probably useless to speculate about the matter at the present time. It is a common phenomenon for various species with normally opposite leaves to change suddenly in their growth to a three-whorled system and then after a time to fall back again to the opposite phyllotaxy. In some cases there are alternative juvenile and mature expressions but such a notion does not seem to fit the Pandanus case.

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A HANDY POLLEN CARRIER

C. E. Leighty and W. J. Sando
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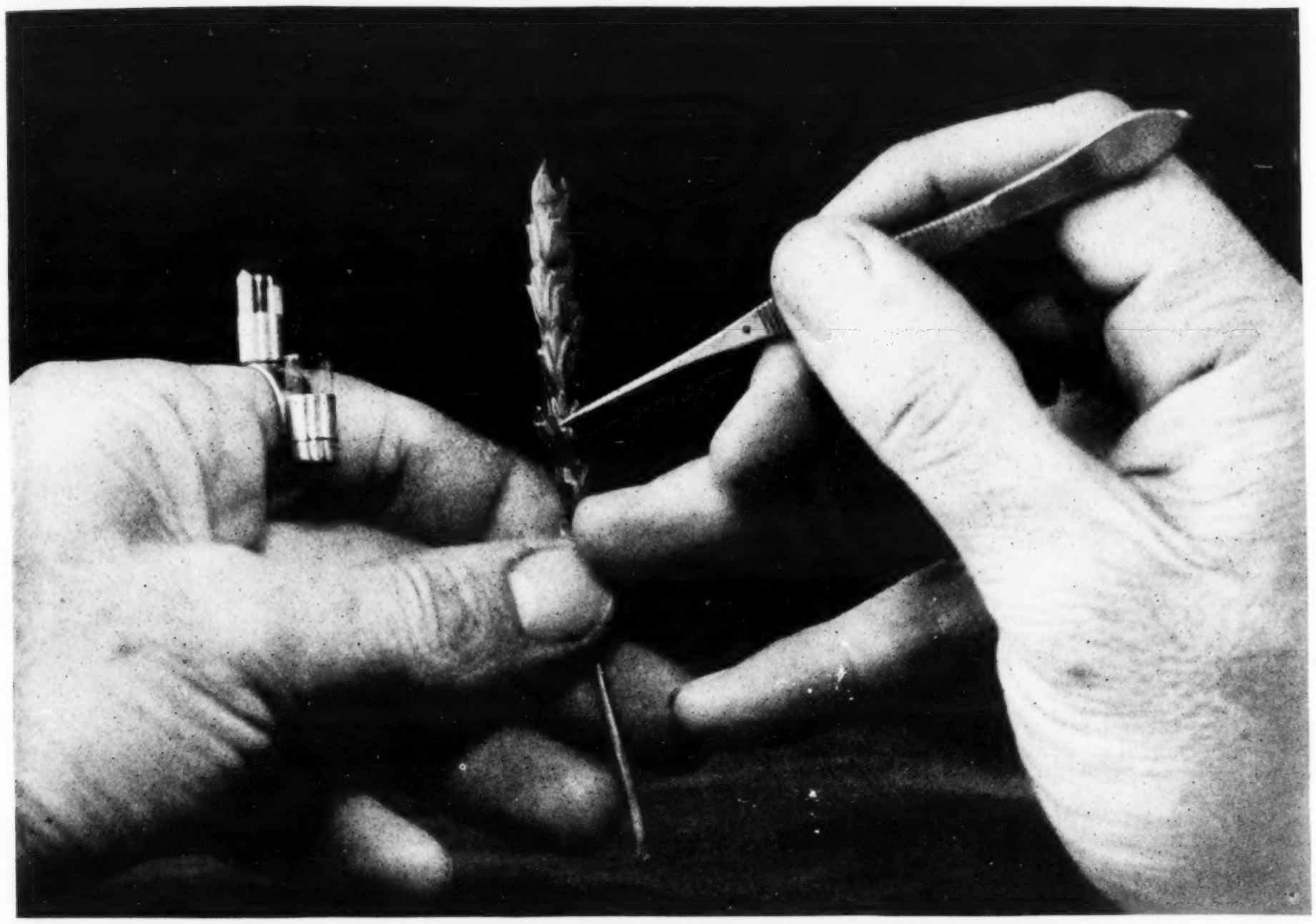
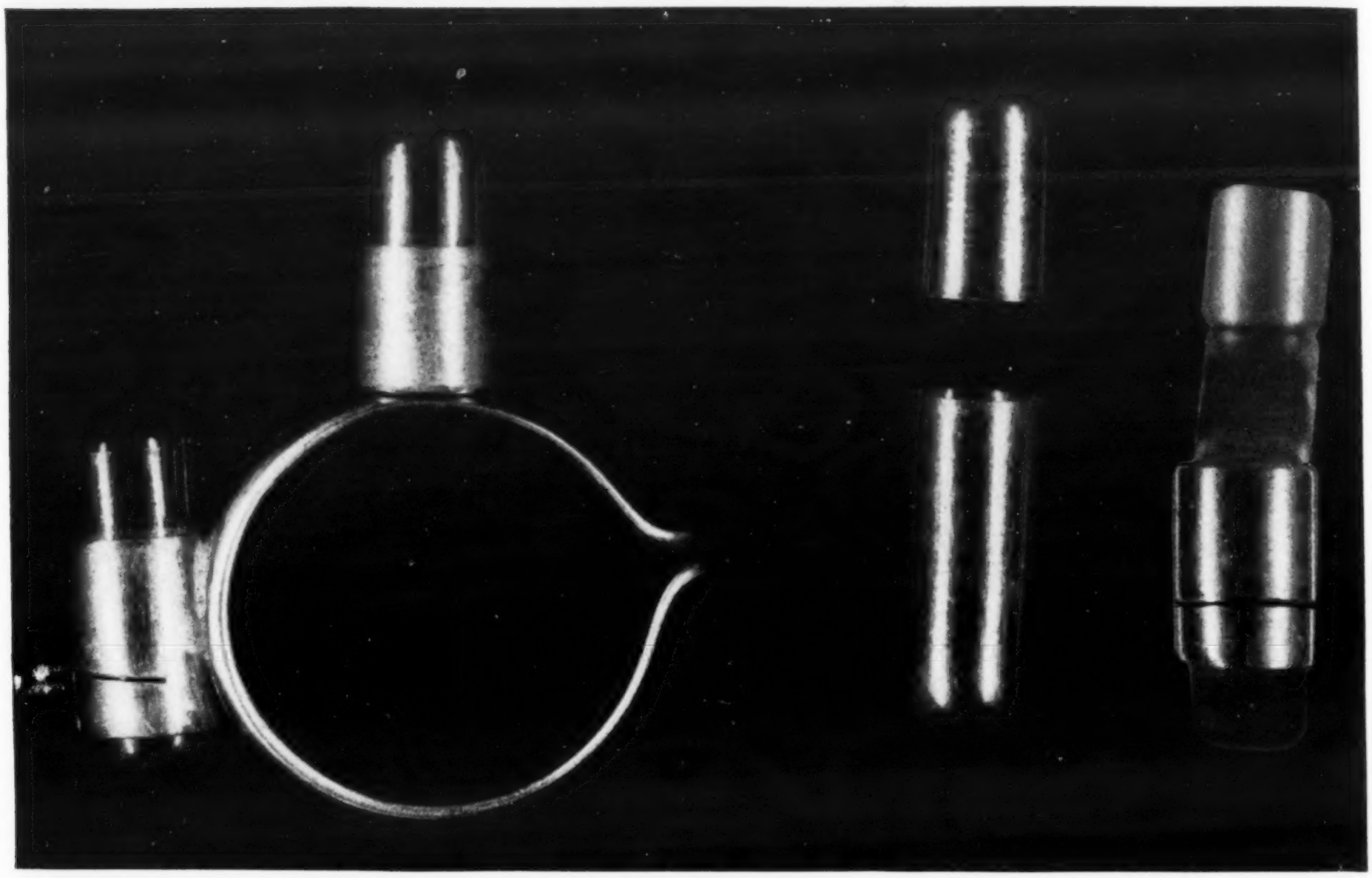


THE POLLEN CARRIER IN USE
Figure 22

Showing how the ring with the capsule inserted in the holder is worn on the index finger, while pollen is being collected from a head of wheat during pollination.

THE artificial hybridization of plants involves the transfer of pollen from the flowers of one plant to those of another, and the degree of success depends in a large measure on the efficiency of this operation. In the hybridization of cereals, in which work the writers have been engaged for several years, dozens of flowers on several heads frequently must be examined in order to obtain the desired pollen. The anthers are small and must be in just the right stage of development. If gathered too early the pollen will not fertilize, if fully matured the anthers may burst and lose their pollen. It is highly desirable, therefore, to have some convenient and safe means by which the pollen can be collected and transferred. This is especially necessary in the field where pollen must frequently be transported several hundred yards.

In 1913 one of the writers began the use of gelatin capsules for this purpose, in connection with his work in hybridizing wheat. The No. 0 size was found suitable. The cap was removed and the capsule attached to the thumb of the left hand by means of a rubber band passed twice about the



ENLARGED VIEW OF THE POLLEN CARRIER

Figure 23

The pollen carrier consists of an adjustable ring fitted with an open cylinder for holding a gelatin capsule and a projection over which the cap of the capsule may be fitted when not in use. Two views of the pollen carrier are shown, with an empty capsule of the kind used shown in the center.

thumb and crossed over the capsule. At times the capsule was simply moistened and stuck to the thumb at the angle desired. A fresh capsule is used for each pollination.

The capsule was found to be quite satisfactory as a receptacle for the pollen, but it was necessary to exercise considerable care so as not to upset it and lose the pollen. There was also some difficulty in keeping it securely attached to the thumb either with the rubber band or by the wetting method.

Several devices for holding the capsules were then tried and, finally, one was designed which has been satisfactory in every way. This device, which may be called a "pollen carrier", is a nickle-plated brass ring, which has been opened at one point and the two ends lipped, in order to permit proper adjustment on the index finger. Attached to the interior periphery of the ring on the side opposite the opening is a small, hollow, nickle-plated brass cylinder 13/32 of an inch long and 5/16 of an inch in diameter, open at both ends, and cut at one end in such a way as to insure a firm grip on a No. 0 gelatin capsule when one is inserted therein. At another point on the exterior periphery of the ring, above the cylinder which holds the capsule and midway between the point of attachment of the cylinder and the opening in the ring, is attached a solid, slightly tapering, nickle-plated brass projection 9/32 of an inch in diameter and 5/16 of an inch long. This is designed to hold the cap or smaller part of the capsule which may be slipped over it when not being used to cover the contents of the capsule. This proximity of one part of the capsule to the other part

permits easy and rapid closing and opening of the capsule. The ring just described is illustrated in Figure 23, and the manner in which it is used as a pollen carrier is shown in Figure 22.

The pollen carrier described and illustrated herewith was made by a local instrument maker at a cost of $1.00 and the gelatin capsules were purchased from a pharmacist at 20 cents per hundred.

The principal advantages derived from the use of the pollen carrier are as follows:

1. Free use of the fingers is permitted, while the receptacle is always conveniently placed, thus facilitating the collection of the pollen and its transfer in pollination.

2. Contamination and other injury to pollen being transported from one point to another is prevented by the use of a bi-partite capsule which safely encloses the contents.

3. Sterilization of the receptacle between pollinations is unnecessary, since a gelatin capsule is discarded after being used for one kind of pollen.

4. The method can be used in connection with work on many kinds of plants.

The Races of Europe

RASSENKUNDE DES DEUTSCHEN VOLKES, by DR. HANS F. K. GUENTHER. Sixth ed., revised, pp. 504 with 27 maps and 539 illus. Price $2.60. Munich, J. F. Lehmann's Verlag, 1924.

The first edition of this book was reviewed in this Journal, February, 1924. It has been extremely popular in Germany, as is evidenced by the appearance of a sixth edition already, not to mention two abridged versions of it that are on sale, one by Dr. Guenther himself and another by a student.

Meanwhile the author has come to the conclusion that instead of four primary races in Europe, there are five. He now distinguishes, among the blondes, a long-headed, small-faced race (the Nordic) and a short-headed, broad-faced race which he calls the East Baltic, and which is found particularly in the Finno-Ugrian sphere, although to some extent in eastern Germany and elsewhere.

This change in basis has necessitated a complete revision of the book, which has also given occasion for many corrections and small changes, and improvement of the maps and illustrations. The latter are perhaps the most valuable feature of the work, at least to a non-Germanic reader. While many details of the book are open to criticism, it remains the most complete source of information available for the general reader, and at a reasonable price.

P. P.

ALBINO WATER BUFFALOES

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AN ALBINO WATER BUFFALO CALF
Figure 24
Both the albino calf and the normal one are about four days old.

ALBINO water buffalo calves are not common in Southern China, except in the island of Hainan, to the north of Kwantung Province, where it has been estimated that about thirty per cent are albino, or, at any rate, are white in color. They are also said to be common in the province of Tonking, in Indo-China. In Hainan and Tonking they are held in especial favor because of their supposed resistance to disease, particularly to rinderpest.

Both the sire and dam of the albino calf shown in the accompanying illustration were of the usual color, which is a grey-black, with light shadings on the legs, but with no pure white spots. Whether the calf is a pure albino may be questioned, since its eyes are pigmented like those of ordinary calves. However, every hair on its body is white.

THE MODERN HEAD HUNTER

A Review

PROFESSOR Dixon's ambitious attempt to give a connected racial history of man* is frankly an experiment, and one that might have had greater hope of success had he called in biological counsel in the undertaking. The recent "White Indian" controversy has presented the unfortunate spectacle of several anthropologists attempting to prove or disprove each other's theories by reference to the "well known" (but unfortunately non-existent) "sterility of albinos." This perhaps may give point to our insisting on biological treatment of racial questions, rather than "logical" analysis.

The Problem

The problem of racial history is undeniably a difficult one, a fact which Professor Dixon states at the start:

> At the very outset we must recognize that the problem is one of great complexity. Whatever our conclusions as to the number and character of the fundamental races, we cannot expect to find these widely spread in their fundamental form today. . . . . (p. 3). It is extremely probable that the real criteria of race are rather complex, and that various external features of pigmentation, hair, form, etc., together with many structural and metrical factors are involved. But we are still in this matter groping more or less in the dark, since we do not know with certainty whether there is any real correlation between the criteria employed.

Only eleven pages later, we are asked to forget all about the difficulties, and in the interest of simplification to accept the following hypothesis:

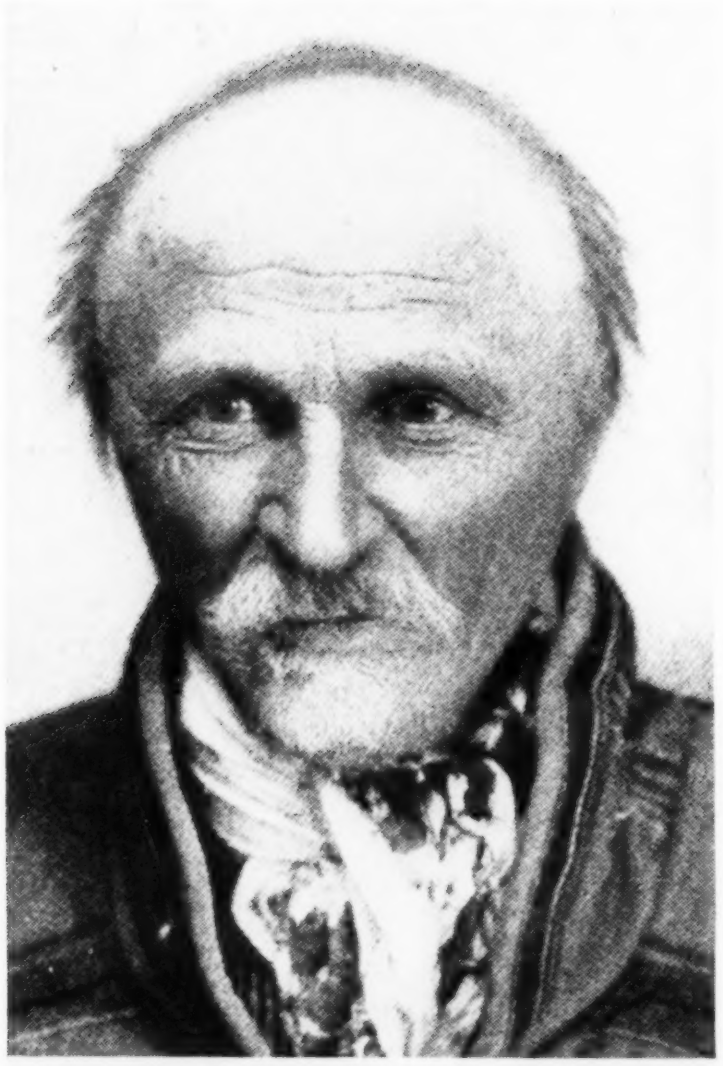
> It has been shown that the usual criteria for the determination of racial types, are, so far as they relate to *external* factors, unsatisfactory, in that they are inapplicable to skeletal data; and that for any comprehensive study of racial problems which must involve historical considerations we must rely on *skeletal*, primarily cranial characteristics. From the relatively small number of such criteria generally recognized as probably of racial significance, which are also analogous for crania and for living persons, and which are furthermore generally available, three were selected. These three indices being divided according to general usage, into three subdivisions each, we obtain a total of twenty-seven possible combinations of these, which may be used as a basis for the analysis of any people. This analysis enables us to determine the composition of the people *in terms of our twenty-seven factors*, and their uniformity or diversity and relationship to other peoples, *on this same basis*. . . . If we are willing to accept as a working hypothesis that the eight groups of this sort are fundamental types, from which the others have been derived by blending, we have placed in our hands a key which will unlock many a door and open far-reaching vistas into the problems of the classification and distribution of peoples.

Discussion of why we should be justified in accepting this novel method of simplifying an admittedly complex matter is deferred until the last chapter, and here the evidence presented is chiefly the correlation between these indices and other cranial measurements. Obviously it is quite possible to undertake the analysis of races in terms of these factors, or any other, but are we really justified, in view of the complexities, in basing conclusions as to relationship on these data alone? Professor Dixon admits that our knowledge of the genetics of the cranial indices is practically nil, and he does not mention parallel evolution, a phenomenon not uncommonly met with in the phylogeny of plants and animals. What evidence we have from genetic studies would rather make us doubt that cranial indices are inherited in simple men-

**The Racial History of Mankind*, by ROLAND B. DIXON, Professor of Anthropology at Harvard University. Pp. xvi, 583. Price, $6.00. Charles Scribners' Sons, New York, 1923.

AZTEC

BUSHMAN



LAPP

SOUTH ITALIAN

FACES AND RACES

Figure 25

Can the great variety of characteristics that go to make up the different races be safely ignored in tracing the racial history of mankind? The illustrations are from Dixon's *Racial History of Mankind.*

delian fashion. "So far then as our present knowledge goes we are probanly justified in regarding head-form, and, by analogy, nose-form as not directly subject to Mendelian inheritance, and in regarding the medial forms as due to blending."

Once having adopted this simplification, Professor Dixon forgets all about the complexities and follows his hypothesis wherever it leads, and not infrequently it leads into strange places. His faith sometimes may be tried, but it never waivers. When it tells him that the Eskimos on the northwest coast of Greenland and the Alikaluf of the Straits of Magellan are closely related, he accepts the conclusion, although they are separated by ten thousand miles, with scarcely a relative between. In fact, many of the charts he presents would very nicely support a theory that head-shape is a function of latitude and altitude. Neither would the author appear to be opposed to such a theory, as he has frequent Lamarckian leanings.

Effects of Environment

In fact, from a biological point of view, his fluctuations between the schools of Weismann and Lamarck are one of the features of the book When his inexorable cranial indices unearth negroes in Norway, he considers that the environment has had a powerful "bleaching effect." This in spite of the fact that the original hypothesis required that the cranial indices shall have suffered no change throughout the ages. Our author "cannot but feel that the fundamental proportions of the skull are elements of great stability, and less likely to suffer modifications than the superficial features of the body." Nevertheless in another place a "strong brachycephalic environment" accounts for some unexpected variations in cranial indices.

We will leave to the biometricians the possibilities opened up by being able to ascertain the racial makeup of ancient nations by measuring four skulls: "The most ancient crania from the whole region are four of Seleucidian age found at Babylon, which show that the Mediterranian and Caspian types were in the large majority, the Alpine making up the remainder." Why not carry this a bit further and see here evidences of a 9:3:3:1 ratio?

It is pointed out at the start that the eight fundamental "types" do not correspond to any present-day races, but for convenience they are given racial and geographical names, and as a result we find old friends peculiarly situated—an island of "Mongoloids" in Central Africa, parts of the Andes populated by "Urals," and others in the Amazon Valley, next to a "proto-negroid" group—a "Caspian" population occupying the northern and southern extremes of the Western Hemisphere. "Proto-negroid" types also appear in Southern California, in the New England States, and in Scandinavia. Solely on the basis of these skull measurements, and often not very many of them at that, the migrations of the human race are traced with amazing results. Language, physical characteristics (other than cranial indices), cultural clues, all count for nothing when the modern head hunter is on the warpath.

The simplification of any biological problem by the adoption of arbitrary criteria is always fraught with danger, particularly when the problem is recognized as being of "great complexity." Any short-cuts should be tested with the most rigorous criticism, and should be checked frequently by the application of all collateral evidence.

The large collection of data assembled here, with an extensive bibliography is certainly of great value, though it might prove more useful if if were not so heavily burdened with interpretation and arbitrary geographic names. In attempting to make a readable and generally interesting book the temptation to sweeping statements

is an ever-present danger and one that tends to make us lose sight of how little is *known* of human heredity, both individual and racial. This in turn discourages the accumulation of the *facts* which are now lacking and which are so necessary for a real understanding of these questions.

Without agreeing with the method, we can still enjoy the excellent illustrations and charts, and hope that some of the hypotheses may prove fruitful. Where the method is applied to limited areas, as was done in Professor Dixon's earlier studies, the results are rather more convincing than where it is extended to embrace all mankind.

Dixon in effect defines a race as a group of human beings which possesses certain cranial indices, discarding general physical characteristics and linguistic and cultural affinities. This is perfectly proper as an hypothesis requiring investigation. Botanists could well define a family as a group of plants having a certain ratio of length to breadth of leaves and proceed to establish relationships on that basis. The test of the definition would come with its application, but if absurdities resulted the definition would have to be discarded. It would be equally proper to make the assumption that club feet measured racial affinities and proceed to distribute races on this basis.

Dixon's definition seems to have resulted in absurdities and the obvious thing is to try for a new definition. While it is true that as far as stability is concerned skeletal and qualitative characters are on an equal footing, it is a well known fact that quantitative characters involving numerous hereditary elements are more easily lost or altered by hybridization than qualitative ones, blending being the general order with characters of size and shape. Hence a black skin may be a more certain indication of negroid ancestry than any combination of cranial indices.

Biological Aspects of Immigration

EUROPE AS AN EMIGRANT-EXPORTING CONTINENT AND THE UNITED STATES AS AN IMMIGRANT-RECEIVING NATION. Hearings before the Committee on Immigration and Naturalization of the House of Representatives; statement of DR. HARRY H. LAUGHLIN. Serial 5-A, with appendices, pp. 210. Washington, D. C., Government Printing Office, 1924.

Supt. Laughlin of the Eugenics Record Office has for some time been making a special study of biological aspects of immigration, under authorization from the Congressional Committee above mentioned. His first study dealt with the foreign-born inmates of American custodial institutions. For this second one he has gone to Europe and studied the immigrant stream at its source. He describes how in Italy, to take a single example, the 42,000 emigrants to the United States which are annually allowed by the present quota, are virtually chosen by the Italian government, which gives the preference to able-bodied young married workers, whose families are left in Italy. These wage-earners, separated from their families, naturally tend to send most of their wages back to Italy, and to return thither themselves in due time; thus the Kingdom makes them a source of income rather than a loss. The second part of Dr. Laughlin's testimony deals with criticisms of his previous study ("The Melting Pot"). Both the body of the work and the appendices contain a wealth of information which those interested in the eugenics of immigration will need. P. P.